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THE

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ASTRONOMY.

ASTRONOMICAL NOTES FOR MARCH, 1878.

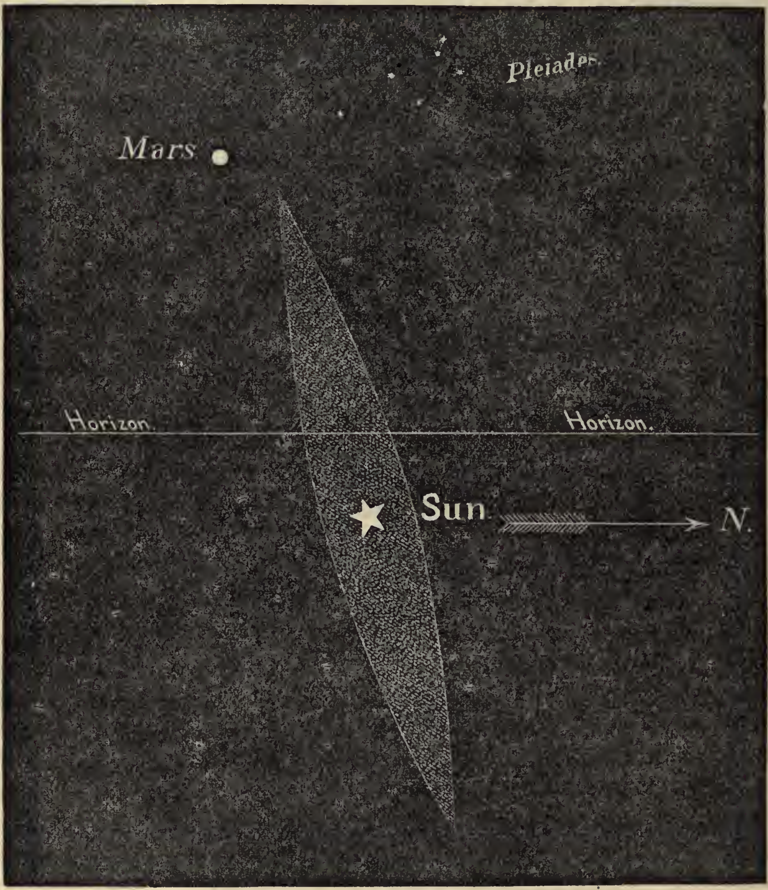
BY PROF. C. W. PRITCHETT, MORRISON OBSERVATORY.

THE ZODIACAL LIGHT.

Some of our recent clear nights have afforded fine opportunities to see this phenomenon at its best. It is, however, really surprising that *so few persons* ever see it during their whole life-time. As I write for students and general readers, rather than for Astronomers, this note is made in the hope of inciting attention to something very *easily seen* and still very *curious.*

The Zodiacal Light, first so called by J. D. Cassini, in 1683, is apparently a faint luminous cone, whose axis extends from the sun, along the plane of the sun's equator, to a distance of from 30° to 105° from the center of the sun. The variable length of the axis is *apparent*, not *real*—and is due to the varying inclination of the sun's equator to our horizon at different seasons of the year. The light is brightest and is recognized as extending farther from the sun the more nearly its axis is perpendicular to our horizon. For hundreds of years to come this season will be March and April for the Western sky, and September and October for the Eastern sky. Any one may illustrate for himself, in two minutes, the *varying* position of this conical axis of light, by revolving a celestial globe, previously adjusted to the latitude of his position. In a minute he can

see that he ecliptic makes the largest angle with the horizon when the *equinoxes* are in the horizon; and since the sun's equator is only inclined 7⅓° to the ecliptic, the projected equator of the sun will make its *largest* angle with the horizon nearly at the equinoxes; and, therefore, we *then see* the luminous cone most nearly perpendicular to our horizon. The apparent breadth of the conical base varies from 8° or 10° to 20° or 25°, as we see it more or less obliquely. It is brightest near the horizon, and fades away by insensible gradations towards the



vertex. The light resembles that of the Milky Way, or that of the tail of a faint comet. During last week the vertex was near the planet Mars, and a little west of the Pleiades. The accompanying figure will show its form and relation to the sun, our horizon, Mars and the Pleiades, at 7½ hours mean time, February 28. Its *form* is that of an excessively oblate spheroid, or lens-shaped body. The *figure* will be recognized as a plane section of the spheroid, made through the center of the sun and at a right angle to our axis of vision.

Many speculations have been hazarded concerning its nature. Kepler thought it might be the solar atmosphere, but La Place showed this hypothesis to be untenable for these two reasons: 1. The solar atmosphere cannot extend beyond the distance at which the centrifugal force, due to rotation, would be balanced by the sun's attraction. This point lies within the orbit of Mercury, or within less than 28° from the sun. 2. The ratio of the axes of the spheroid of atmosphere must be within these limits, Major : Minor : : 3 : 2, while the *actual ratio* is incomparably greater. Cassini thought it might be the blended light of an innumerable number of very minute bodies revolving round the sun. Euler thought it proceeded from the repulsive energy of the sun, after the manner of comets' tails. Sir John Herschel says: "It may be conjectured to be no other than the *denser parts* of that medium which we have some reason to believe resists the motion of comets, loaded, perhaps, with the actual materials of the tails of millions of these bodies, of which they have been stripped in their successive perihelion passages." In conclusion, it is but right to state that *trustworthy* observers have testified to the *simultaneous* presence of the luminous cone in both Western and Eastern sky. See Gould's Ast. Journal, No. 84, for May, 1855; also Monthly Notices R. A. S., vol. xvii., and Fourth Ed. U. S. Exploring Narrative, Washington, 1856. Of the same tenor is a communication of Humboldt to the Berlin Academy, July, 1855. Mr. Jones, Chaplain of the U. S. steam frigate Mississippi, during a cruise round the world, had *very rare* opportunities for observing the zodiacal light in all latitudes, and seems to have improved them very diligently. He remarks: "It seems to me that these data can be explained only by the supposition of a nebulous ring, with *the earth for its center*, and lying within the orbit of the moon."

SIRIUS.

This distinguished star is now near the Meridian during evening twilight, and 56° south of our zenith. The *brightest* of all the fixed stars, it *just now* compels the attention even of the most *casual observer*. From remote ages it has been called the Dog Star. (Canicula.) Its proper Astronomical name is Alpha Canis Majoris. The ancient Egyptians gave it the name Sirius, from Siris, one of the appellations of the Nile, because they noted the annual inundations of that river to occur at a certain rising of this star. Not only in antiquity, but in times comparatively modern, the most malign influences have been ascribed to this resplendent sun. See Georg. Virg. IV, 425, Æneid III, 141, Æneid X, 273, and numerous passages in modern writers. This malign influence was supposed to culminate in the season known as dog days—"diebus canicularibus." This indefinite period of about 40 days begins when Sirius rises and sets heliacally—that is, *with* or *nearly with* the sun. Such a concurrence now requires the sun to be situated in Cancer, near Præsepe. In antiquity this rising of Sirius came early in July, and Dog Days embraced the hottest part of the summer. Owing to the Precession of the Equinoxes, they now fall in a cooler season of the year, beginning early in August, so that hot days, raving madmen, rabid dogs, parched fields

and malignant fevers no longer come because "the Dog Star rages." The light of Sirius is now intensely white; but it was anciently described as red or yellow, and Seneca says it was ruddier than Mars. Its Parallax is about 0.2″, and therefore it is about one million times more distant from us than our own Sun; and yet its brightness is so dazzling that the eye can scarcely bear it. Its approach to the field of a large telescope is heralded by a halo of light which grows brighter and brighter, until the mighty orb, equal perhaps to eighty of our suns, appears in overpowering splendor. Dr. Huggins, President of the Royal Astronomical Society, London, and our countryman, Mr. Rutherford, find by the Spectroscope that Sirius, like our own Sun, is enveloped by an immense atmosphere of Hydrogen under great pressure; and the peculiar position of one of the hydrogen lines indicates a motion of *direct recession* from our system at the rate of more than 20 miles per second. It has also a proper motion, nearly at right angles to our line of vision, of about 15 miles. The resultant of these motions gives a motion in space of about 30 miles per second. Some of the most recondite labors of astronomers have related to the proper motion of Sirius. The peerless Bessel gave it his most searching investigation. Still there was a concealed element of perturbation until the year 1865, when Mr. A. G. Clark first saw with the Chicago refractor its companion star. The first decisive measures (so far as I know,) of the *position angle* and *angular distance* of the companion of Sirius, were made with the great 26-inch refractor of the Naval Observatory, Washington. Lately Herr Tempel, of Florence, in charge of the observatory at Arcetri, (the old home of Gallileo,) met with a remarkable *experience* in investigating the companions of Sirius. His instrument, the Amici refractor, seemed to reveal *another* companion between Sirius and the Clark star. But unfortunately, when he turned the telescope on Venus and some other bright stars, he still saw the same minute companions, which apparently are only "ghosts," having their origin in light doubly reflected. Herr Tempel seems to conclude that even the Clark companion is but a "ghost" of false light. It may serve to show the difficulties of these observations to add that the learned and veteran astronomer Otto Struve, at Pulkova, for several years mistook a "ghost" for a companion of Procyon. The Washington refractor was also the first to remove this illusion. For the same reason we sometimes hear of new companions to Polaris. Last year a Frenchman reported two. In view of all lately said in highest astronomical circles on the companion of Sirius, I can but feel some gratification relative to measures I have lately made of the Clark companion. I can confidently risk the following values of the position angle and distance of this attendant of Sirius:

Date.		Position Angle.	(Wt.)	Distance.	(Wt.)	No. Comp'ns.
1878.	Feb. 26.	57°.25	(4)			4
	" 27.	58°.23	(3)			5
	" 28.			11″.140	(5)	6
	Mar. 5.	55°.55	(4)	11″.341	(4)	6—2
	" 6.	54°.83	(4)	11″.344	(4)	7—6
Mean		56°.41		11″.265		

The following measures were published by Prof. Hall, in Ast. Nach. 2097, all made on the Great Refractor, at Washington:

Date.	Observer.	Pos. Angle.	Dist.	No. Comparisons.
1876.033	Watson, Ann Arbor, Mich.	57°.8	11″.12	1—1
1876.055	Peters, Clinton, N. Y.	54°.6	11″.45	1—1
1876.095	Holden, Washington.	54°.87	11″.822	6—5
1876.219	Hall, Washington,	55°.22	11″.193	6—6

The values given in the Washington observations for 1874 are for the Pos. Ang. generally *larger* than those above. The mean of Prof. Newcomb's values for that year, giving the observations equal weight, are:

Pos. Ang., 59°.33; Dist., 11″.53.

PLANETS.

Saturn. The disappearance of Saturn's Ring, (Feb. 6.) was watched, with much interest, by Astronomers all over the world. Fortunately, the weather here enabled us to share that interest. On Feb. 3rd, 7½ p. m., (the planet being low in the S. W.) the Ring was very carefully scrutinized for half an hour. It appeared projected on the *Ball*, as a very sharp, fine, *dark line*. On each side of the Ball it was still *distinctly* seen as an *excessively* fine, *continuous*, *white line*. Three Satellites distinctly visible on the following side.

Feb. 4, at 6½ p. m. For twenty minutes a wide opening in the clouds afforded a fine view of Saturn and his vanishing Ring. Across the Ball the Ring was still distinctly seen, sharply projected in a fine, dark line. The ends towards the ansæ, still very fine, white lines—in some parts a series of bright, *broken lines*. Two Satellites visible.

Feb. 5th, at 6½ hour. The projection on the Ball could be seen but not *constantly*. On the *preceding* side the Ring could only be seen near the Ball—on the *following* side was a diffusion of light near the ansæ, which may have been caused by a Satellite; for the *seeing* was very much interrupted by atmospheric disturbance. Three Satellites seen.

Feb. 6th, 6½ hours. Observed the Ring when planet was *too low;* also a haze impaired vision. No traces of the Ring on either side of Ball, except perhaps near the ansæ, and this appearance was very uncertain. On the Ball, with the *highest effort* of vision, I think I could detect faint traces of the Ring. One thing was *certain*—this wondrous appendage of Saturn had vanished. The shorn appearance of the great planet quite disgusted my youthful assistant, who declared "he looked worse than a peacock with his tail pulled out." The Ring having remained invisible nearly a month is now beginning to show again; but Saturn is too near the Sun for any valuable observation.

Mars is a little S. W. of the Pleiades, and is filling the important post of "Evening Star" as well as his shorn glories will allow.

Neptune is invisible to the unassisted eye, yet, with Mars, is doing duty as "Evening Star." With a good spy-glass any one may see him now at a point a

little S. of the half-way point between Alpha Arietis and Alpha Ceti. The trouble will be to *know* him when seen.

Uranus is now in a position that, on a clear night, (the Moon being absent,) any one may identify him with the unassisted eye. Find Regulus (Alpha Leonis) and then look about 1½° W. and nearly 1° N., and you see Uranus. The eye will have to be practiced a little to recognize him. It is now retrograding, or moving west. Nothing can show more decisively the superiority of modern achromatic telescopes, over the earlier instruments of Sir William Herschel, than the fact that Sir William remained so long in doubt as to the character of the "Georgium Sidus." For a long time he considered it a comet. A very moderate refractor of the present day soon reveals its true character. The satellites of Uranus are plainly seen in our Equatorial, but no effort has yet been made to measure them. Extended measures of 4 of them, also of the satellite of Neptune, made with the Great Refractor, at the Naval Observatory, were published by Prof. Hall in Ast. Nach. 2097. Jupiter and Venus are now both morning stars, and are very conspicuous in the eastern sky in morning twilight. Jupiter is still very far south—more than 20° S. of the Equator. He has, however, been returning northward since Nov. 1. Still, several years must elapse before he will be favorably situated relatively to the observers of northern Europe. His variegated belts and his satellites, with their *transits*, *shadows*, *occultations* and *eclipses*, are objects of *unceasing* interest to the astronomers. Thus on Aug. 15th, 1876, while Sat. No. I was under occultation, I saw at the same time the *shadows* of Satellites II and III, projected on the disc, while No. II itself was just passing off the preceding limb.

Mr. Barneby, of Morton House Observatory, England, reports that on July 21st, 1867, he saw *three satellites* and *three shadows* projected on the disc at the same time—a rare sight indeed.

Mercury is also a morning star; but is too near the sun to be seen. He will reach superior conjunction March 20, and at his ensuing *inferior conjunction*, May 6, (civil time,) transits the disc of the sun. Extensive preparations are being made by astronomers to observe this transit of Mercury, chiefly to afford the "data which will be decisive of the question, whether the result of Le Verrier, that the motion of the perihelion of Mercury is much greater than that due to the action of known planets *is really correct.*" In other words: The observations are wanted to indicate the *probabilities* of an Intra-Mercurial planet—already named, in advance, Vulcan. Instructions drawn up by Professor Newcomb, of the American Nautical Almanac, have been issued by Admiral Rodgers, from the Naval Observatory, inviting coöperation and uniformity of observations. We hope to be able to take part in these observations.

ASTEROIDS.

This observatory was promptly notified by telegraph during the last month, through the Smithsonian Institution, of the discovery of three new minor planets,

of magnitudes 10, 11, 12, respectively; all found by Palisa, at Berlin. Unfavorable weather has not allowed us to follow them.

METEOROLOGY FOR FEBRUARY, 1878.

Height, 700 feet above sea level.

Highest Barometer,	Feb. 26,	29.612 in.	Reduced to sea level,	30.343 in.
Lowest "	Feb. 21,	28.590 in.	" " " "	29.106 in.
Mean "		29.162 in.	" " " "	29.906 in.

Highest External Thermometer,	54.50F.,	Feb. 5.
Lowest " "	26.00F.,	Feb. 10.
Mean " "	40.59F.	

Rainfall for the month, 3.133 inches.

On Feb. 21 the barometer was lower than at any date since Oct. 20, 1876. *That date* was marked by a violent S. W. wind lasting 7 hours, the sun shining brightly and broken clouds flying. No rain. This *latter fall* by gentle N. E. winds and very heavy rains.

ASTRONOMY AND THE CALENDAR.

Professor D. G. Eaton, of the Packer Institute, Brooklyn, New York, lately delivered a lecture in that city on the above subject:

There are three great natural units necessary to the measurement of time. These units are found in the movements of the celestial bodies. The first is the revolution of the earth upon its axis, which measures day and night. This is the foundation of all measurement of time. The rising and setting of the sun is not uniform, but the time of the rising and setting of a star, such as Sirius, which may be seen near the meridian, is the same throughout all agse. It was the same a thousand years ago, and will be the same a thousand years hence. The other natural units of time are the month and year. Such an adjustment of the civil to the natural year as shall cause the perpetual recurrence of the seasons upon the same month is what constitutes the calendar. The artificial units of time are the week, hour, minute and second. The account of the origin of the week can be found nowhere except in the books of Moses, though it is a division of time that was known to all the civilized nations of antiquity. It was not, however, until after the time of the Emperor Theodosius that it was introduced among the Romans. The lecturer at this point gave an explanation of the way in which the days of the week were named by the ancient Egyptians and renamed by the Saxons. He also gave an account of the confusion which was caused in the Roman calendar by the vanity of the Emperor Augustus, who, after having the eighth month of the year named after himself, caused another day to be added to the number which it contained before, that the month of July (named after Julius Cæsar) should not exceed it in length. To regain the balance of days in each month, one day was taken from both September and November. English jealousy of the Papal power also caused confusion in the uniformity of the calendar

by hesitating for more than two hundred years to accept the change in the old style of reckoning recommended by Pope Gregory and accepted at once by all Catholic countries. It was in 1752 that the new style was adopted in England by act of Parliament, and it has not yet been introduced into the Russian Empire. The motive which induced Pope Gregory to make this important change, which for a long time created so much confusion, was merely to regulate the recurrence of Easter Sunday. Though the motive was apparently of such slight importance, yet the result has been of great good to mankind. It is still a matter of difficulty for chronologists to settle the date of events which occurred in the remote past, and their task has not been lightened by the changes made in the calendar by some of the Roman emperors and the pontiffs of the Catholic Church. Professor Eaton's lecture was illustrated by off-hand sketches on the blackboard.—*Scientific American.*

TRANSIT OF MERCURY.

The arrival in this city of two French scientists, on their way to the West to make observations on the transit of Mercury, indicates the interest with which that astronomical event will be regarded. These gentlemen are sent out officially. M. Charles Andre is Director of the Observatory and Professor of Astronomy in the University of Lyons; M. Angot is Professor of Physics at the Lycee Fontanes, in Paris. They are to proceed to Ogden, Utah, there to make observations on May 6. Ogden has probably been selected for two reasons. It is upon very elevated ground, being nearly on the "divide" of the continent, and offers great advantages in dryness of climate and purity of atmosphere. It is also a point where the center of transit will be nearly at local noon. The transit will occupy about seven and a half hours. Observations will be of service in determining the orbit of Mercury, and thus throwing more light upon the question of an intra-Mercurial planet; and also in furnishing the data for fresh estimates of the distance of the sun.

GEOGRAPHY.

POLAR EXPLORATION IN 1776.

TRANSLATED BY PROF. E. L. BERTHOUD, COLORADO SCHOOL OF MINES.

Extract from the journal of Capt. Pagei, of the French Navy, who, in a Dutch ship in April and May, 1776, made a voyage to the north of Spitzbergen, to Jan Mayen Island, to the land of Gail Hawkes, in the N. E. part of Greenland, with his views on the possibility of reaching the North Pole. Capt. Pagei reached in May to a point above 81° N. lat.

"Remembering all I have seen of the motion of the ice pack, and the wish I had to penetrate to the North Pole; when on this trip we had reached beyond 81° North latitude, I reflected seriously upon the practicability of this idea:

"The force of the several motions of the ice pack had convinced me that in the coldest winters the sea congealed by a hard frost must soon be broken up by the motion of the larger ice floes.

"The conformation of floes formed of several pieces made this certain to me.

"The parts that froze and joined together the ice sheets that I saw must be the water space between the floes, which became compressed and thus drifted around.

"I believe that this motion of compression (in English, nipping) takes place in all the ice covered seas, and even at the poles if there were seas there, and where we would always find currents. If this theory of mine is just, the ice pack has space to move in, and all the surface of the polar seas is not, therefore, wholly covered with ice; and therefore navigation is possible there.

"I saw in this voyage, at 81° north latitude, the sea suddenly and rapidly freed from ice, that *had drifted north*, where evidently it had drifted into open water.

"I knew also that some Dutch ships in 1773 had, as late as the end of November, safely sailed out of the great northern ice pack. The expeditions of the Dutchmen, Heemskerk and Banentz, to the northeast of Nova Zembla, and those Russian explorers of the sea spaces between the rivers Lena, Obi and Yenisei, told me that they were sometimes beset and again free from all ice fields. The movements of the ice pack were thus prolonged until the end of November also in the Siberian seas. I think, however, that these two seas are the least favorable for a polar expedition.

"The seas of Siberia having no issue south, a restricted one east or west must keep continually the greater portion of its heavy ice; while the sea of Spitzbergen, receiving the currents from the east, has the drift ice added to its own ice fields. I think, therefore, that the space comprised between Spitzbergen and Nova Zembla is the most practicable, on account of its width and extent. The experiences of former travelers, and the motions I had seen of the ice pack, showed me we must keep away from land.

"I however do not believe that N. NW. of Nova Zembla we would find any sea entirely free from ice, but a sea only partially encumbered by it, which would give us a navigation as easy as that we have had to a point sixty miles to the north-west of the island of Spitzbergen.

"A ship destined for the North Pole should start from the streams of the German Ocean in the end of February, so as to reach the edge of the ice pack by the end of March, there to wait for the first favorable opening. Whale ships frequently reach the parallel of 80° north latitude the 15th or 20th of April. Those who go to Davis' Straits generally leave about the 1st of March, and we know these regions are far more tempestuous than the more northern seas. The month of March and the beginning of April would in no manner be too early; for April, May and June are the cleanest months for navigation, as July and August are foggy and rainy.

"As, however, we penetrate farther north, from the lessened force of the sun's rays, we necessarily must have there less fog and mist than in the more southern latitudes, and much less solar evaporation."

We give to our readers this short summary of what an experienced traveler and a good sailor, one hundred years ago or more, gave as his idea of the feasibility of reaching the North Pole. The interest taken in Capt. Howgate's plans, and the late discovery of Franz Joseph Land, north of Nova Zembla, by Peyer I. Meypreslet, the Austrian explorer, have in this old voyager's experience been fulfilled. The Austrian expedition took the very same course recommended by Capt. Pagei, and discovered the circum-polar continent or archipelago.

Capt. Pagei also made part of an expedition (French) of discovery sent out first to find the continent alleged to have been discovered east of the Cape of Good Hope, by Capt. P. Gonneville, 1503-4. They discovered some islands on the shore of the South Antarctic Continent, before unknown, and saw these lands previous to Capt. Cook's voyage to the South Antarctic Ocean. E. L. B.

GEOGRAPHICAL PROGRESS.

The annual address of the President of the American Geographical Society furnishes, as usual, an interesting review of the past year's work in geographical exploration. The grandeur of Stanley's achievement dwarfs all the rest to relative insignificance; nevertheless enough else was done in other parts of the world to make the year a notable one for geography, even with Stanley's work left out.

In our own Western Territories, and in certain portions of South America, an unusual number of expeditions for geographical exploration have been sent out; and considerable good work has been done, also, in Central and Eastern Asia, the Indian Archipelago, and Australia. In Asia many explorers have been at work in Palestine, Persia, Turkistan, Thibet, China, India, and Japan. In South America, Rivira and Werthemere have explored the mountains of Peru; Weiner has been at work in Bolivia, and Moreno in Patagonia.

At home the explorations of the United States corps of engineers have been, as our readers already know, both extensive and notably successful. The same may be said of the surveys under the direction of Professor Hayden. Of more immediate interest to ourselves has been the resurvey of the Eastern portion of our own State. The triangulation has been carried through the eastern central part of the State, covering an area of 3,000 square miles between the Hudson river and the sources of the Mohawk, as far west as Utica, and embracing parts of eleven counties. During the coming season the triangulation will be carried across the entire State. The work is of the highest order of accuracy, every important point being located with absolute precision. Thus far the survey has not found a single town where it was represented to be on the old maps, many of them being a mile out of the way.

In Central America the reconnoissance of Lieutenant Wyse, of the French navy, has exploded the reports which the French have held to, (in spite of the

abundant testimony of American explorers to the contrary), that a ship canal without locks was possible across the Isthmus of Darien. His conclusion is that no navigable channel is possible between Tuyra and Otrato, without locks or tunneling. The researches of Dr. Le Plongeon among the ruins of Chichen Itza, Uxmal, and Aké, in Yucatan, and on the once-famous islands of Azumel and Mujeres, are mentioned with commendation; and the doctor's claims to the discovery of written and other evidence of communication between the people of Yucatan and the ancient people of the west coast of Africa are favorably noticed.

No real work was done in Arctic regions; considerable attention, however, is given to Barry's reports with regard to the finding of relics of Sir John Franklin's ill-fated expedition, near the Gulf of Boothia, north of Hudson's Bay. Sir Leopold McClintock has intimated to the British Admiralty that Barry's story is not worth much; Justice Daly, on the other hand, is convinced that Barry not not only means to tell the truth, but has a sufficient acquaintance with Esquimaux speech to make his report of Esquimaux stories trustworthy. He believes, further, that the information Barry gives is sufficient to justify the sending of an expedition to examine the spot where the Netchelli say the white men died, and where their cairn is, containing books and papers.

Stanley's conquest of the Congo is next reviewed at great length, and his course in fighting his way, when opposed, is unreservedly justified. Summing up the whole of Stanley's work in Africa, the speaker said, "It may truthfully be said that no man has ever, in explorations upon the land, done so much for the acquisition of geographical information," and with respect to the Congo and the Nile, "He has solved an enigma that has attracted the attention of the world for ages, and has fixed his name in the foremost rank of geographers, explorers, and travelers."—*Scientific American.*

FOREIGN CORRESPONDENCE.

SCIENCE LETTER.

PARIS, February 19, 1878.

That high authority, Claude Bernard, states consumptive diseases are curable, as well as all others which use or consume the organism, such as scrofula, gout, diabetes, inveterate drinking, etc. Respecting the latter malady, drunkards can be cured, but on condition that the stimulants be gradually withdrawn. To suppress alcoholic drinks suddenly would result in the certain death of the patient. In the case of consumption, irrespective of its origin, not much medicine is required to kill the disease. The remedy lies in a rational hygiene, practiced

with exactitude and severity. Patience is above all necessary on the part of the sufferer, who must not agree with La Rochefoucauld, that the excessive curing of one's health is in itself a malady. The majority of consumptive people who die are those who either could not or would not cure themselves. Individuals afflicted with phthisis, and whose social position condemns them to work and live in vitiated atmospheres, are doomed to certain death if they cannot remove to the country. People in comfortable circumstances can be cured if they adopt, at the commencement of the malady, ordinary precautions. These observations constitute the *credo* of doctors whose specialty is to treat consumption.

M. Bouchardet calls pulmonic, and kindred affections, maladies of "physiological misery," which is very true, as they spring from a general alteration of the organic functions, owing to a default of tone: the organism lives no more, because it nourishes itself no more. Take a consumptive patient out of the contaminated medium in which he lives; place him during the summer among the Alps and the Pyrenees, and in winter on the shores of the Mediterranean; if he live the life of a patient, and not that of a man of the world, avoiding fatigue, cold and humidity, this mode of existence will bring about a complete cure. It must not be concluded that climate has in itself anything like a panacea; a temperate climate offers the afflicted only opportunities for safe and salutary exercise and the conditions for a better appetite. But the more one advances in years the less sensibly these changes are felt. However, in the eyes of doctors, we are old or young at all ages, that is, we represent the age of our organs.

It is, above all, in diabetes that the necessity of minutely following medical injunctions becomes apparent. It is a disease where the sufferer may be said to gradually dwindle away; let him grow fat or let him get lean, he loses his moral and physical forces, and becomes every day a more certain prey to exhaustion. The afflicted may eat and drink voraciously, but gains nothing in energy; the system expends more than it receives; the constitution resembles the sieve of the Danaides, and the patient actually dies from starvation—while eating and drinking even to excess—if not carried off by pulmonic inflammation. In general, diabetic persons are rich, and so can cure themselves; but it is a mistake to conclude that this disease, as well as gout, is the peculiarity of millionaires; these maladies avoid persons whose occupations are of the manual and out-door kind, and go to seek the denizens of comfortable firesides and delicately served tables—the banker, the notary and the politician. Next to notaries, priests are most subject to diabetes, not as the consequence of dining at rich parishioners' tables, but having to make long fasts, they have to indulge afterwards in copious meals, which fatigue the stomach; then their attendance in chapel affords but little time for exercise, and the building itself presents the extremes of heat and cold, for nothing produces diabetes more quickly than a cold, humid atmosphere, and the contrary is the most efficacious remedy, as well as all manual sports, garden laboring, but especially gymnastic exercises. These restore the functions of the skin and the action of the digestive organs.

The dietary for the diabetic reveals some curious scientific facts: it ought not

to be farinaceous, as the fecula becomes changed into sugar, owing to the saliva producing fermentation. It was thought that if peas and kidney beans could be introduced unbroken into the stomach, and thus escape mixture with the saliva, that a sufferer could enjoy a change of food, but Claude Bernard has demonstrated that sugar is produced in the intestines by the fermentation promoted by the secretions of the sweet-bread. Mountaineering is excellent for the diabetic, because it exercises the lungs, compelling all their cells to work, for it is a law that organs which do not work degenerate; hence, why idle lung-cells soon contain deposits of hard, diseased matter, which becomes purulent—this is tubercular consumption. Almond biscuits are better than gluten bread in diabetes, and effervescing beverages should be avoided: the appetite ought never to be fully satisfied, and sobriety as much observed as exercise. The remedy is not in the chemist's shop but in the kitchen, and our legs are the most powerful allies of the stomach in the process of digestion.

The scientific world is indulging in a kind of *fete* in honor of the discovery of "the liquefaction of the gases," and which is a striking proof of the exactitude of modern theories. For the chemist, as for the philosopher, matter is only one, for whom variety in bodies depends solely on the grouping of the constituent atoms; being more or less dense or gaseous as these atoms are kept asunder by the heat they contain. Thus a gas is but a liquid deprived of its heat, and a solid only a liquid from the same cause. Again, theoretically the difference between gas and steam is slight: gas is steam largely distant from the boiling point. It remained, however, to demonstrate that gas was but vapor, and even only a liquid. Monge transformed into a liquid that suffocating gas generated when a sulphur match is burned, in the form of sulphurous acid; Davy and Faraday liquefied chlorine, and Pouillet carbonic acid, ammonia, etc. Thilorier produced solid carbonic acid, and that oxide of nitrogen, or laughing gas, which dentists employ in "painless tooth extraction." Solid carbonic acid resembles snow; if a portion of it representing a temperature of 200 degrees below zero be placed on the hand, no severe cold will be experienced, because the gas in slowly volatilizing separates it from the skin; but touch the acid on the upper side, and the skin will be seared as if with a red-hot iron.

Till a few weeks ago there were five gases that resisted the highest pressure, the best known of these were oxygen and hydrogen, which form water when combined, and nitrogen and oxygen that constitute common air. Messrs. Cailletet, in Paris, and Pictet, at Geneva, have liquefied these gases. The former has devoted ten, and the latter five, years to the experiment, which demonstrates that all bodies can take a solid, liquid, and gaseous form. When a gas is compressed, its atoms are brought more closely together, and the heat which kept them asunder, is set free. Less than the thousandth part of a cubic yard of gas contains one milliard of milliards of atoms. When a compressed gas is liberated it seizes, in order to expand, on the heat in its vicinity, and this seizing of heat produces cold, to as much as 636 degrees below zero, according to Poisson. M.

Cailletet has utilized this freezing power, which is the secret of his success. He places a strong glass tube in a kind of solid bomb shell; the closed end of the tube projects; the tube being filled with the gas, a force pump drives a column of mercury into the tube, piston-like, which in turn forces the gas to the end of the tube, reducing its volume 300 times less; the pressure being suddenly withdrawn, the gas in expanding seizes any heat in the vicinity of its atoms, producing such a low temperature that a portion of the gas becomes for a few moments cloudy, then some beads of liquid are formed, or several flakes of snow-like matter. Such is the discovery in all its simplicity. M. Pictet has obtained one and one-half ounce of liquid oxygen, which has the density of water, and in which carbon burned with extraordinary brilliancy. There were flakes of solid oxygen in the liquid. M. Cailletet obtained drops of liquefied common air. No industrial or commercial advantage is to be expected from these beautiful, these wonderful discoveries; air from the country cannot be manufactured into wafers, nor that from the Alps imported in blocks, or struck into medals. It is the chemist, not the poet, that "gives to airy nothing a local habitation and a name." Liquefied oxygen can neither be employed as an elixir, nor as a blow-pipe in factories. It could not be contained in an ordinary bottle, for, in expanding, it would knock down a man, and the liquid would burn him like a corrosive. Besides, Paul Bert has shown that compressed oxygen is poisonous, and in a liquid state would kill more infallibly than prussic acid. In an industrial point of view, compressed oxygen would be too costly; further, the ordinary machines for supplying furnaces with condensed air are as ample as they are cheap.

M. Rambossen, in his work on the *Harmony of Sounds*, professes to cure nervousness by means of music; following the nature of the crisis, he would prescribe the music of Meyerbeer, Herold, etc. The idea possesses originality at least. Animals become cruel, mild or timid, under the influence of music. Pending the First Revolution, a concert was given to the elephants in the Zoological Gardens of Paris; the orchestra, composed of noted musicians, was concealed; on hearing the sounds, the elephants pricked up their ears, quit eating some tempting food, approached with lifted trunks and marched to the measure to the spot from whence the sounds proceeded. Arago relates that Ampére could not bear learned, complicated music, but that he cried like a child, when listening to a simple air. As a proof of the influence of music on the nervous system, it is only necessary to observe the howling of a dog — thus testifying his disgust — to the grinding of a barrel organ; the animal, however, will not protest if a lively song be executed in its presence, and it listens to the melodious tones of a harp. There is music for dogs, as for men, and this thesis the author has ably sustained before the Academy of Science.

When the hand is placed on a leaf attached to a plant, and exposed to the sun, the sensation of cold is experienced; if the leaf be plucked, and then placed on the hand, heat is felt. M. Boussingault explains this physical function

to the cessation of the ascent of the sap in the leaf, and the consequent suppression of that evaporation which is the cause of the cold. M. Fautrat continues his interesting studies on the influence of forests on soils and climate. The frigorific action of a forest is most marked in summer, in woods of "leafy" trees the temperature is lessened by one degree, and in the case of pines by half a degree more. The finer the constituents of a soil, the more slowly are the sun's rays absorbed. For resinous trees, other than pines, the temperature is higher during the day — the solar heat retaining the vapors above the tops of the trees; hence, this *milieu* humid and warm, in developing a vigorous resinous vegetation on poor soils. By reason of the differences in temperature above, beneath and around forests, there is a constant circulation of currents, carrying the vapors of the soil above the summits of the trees, connecting thus with the clouds, and acting as lightning conductors, for it is well known that forests keep away hail storms.

Many hold that the flesh of mammiferous animals is the prototype of a complete alimentation. However, it is not the less true that the peasantry in France do not possess an appearance less robust or healthy, because partaking of meat only two or three times in the year. Instead, they have milk or lard with their wheaten or rye bread or potatoes. Drs. Bertillon and Gübler maintain that persons who live on a vegetable diet have their arteries prematurely hardened, owing to carbonate and phosphate incrustations — not unlike the deposit on the inside of a kettle. Instead of being yielding and supple upon being touched, the artery feels hard like the barrel of a quill, resembling the condition in advanced age; ruptures of the arteries ensue. Rich people partake largely of meat and albuminous food containing but little mineral matters, and so their arteries remain elastic; a vegetable diet represents much calcareous salt, that is deposited, or lines, the insides of the arteries. This chalky degeneracy is said to be very common among rice-eating people.

M. Guellemin has brought out a fifth edition of his *Ciel;* it may be said to be re-written; the explanation is clear, the style simple, and the method natural. There are ten years of new observations in the work, and the numerous plates of the phenomena of the heavens make us feel that we are surveying space with a telescope. But nothing is left to caprice or imagination; the author, by a pencil as lucid as his pen, has constituted himself a kind of eloquent secretary of all the observatories of the world. Even astronomers will peruse the book with pleasure.

F. C.

THE GERM THEORY.

From the Popular Science Monthly.

In your February number, Dr. J. R. Black assumes to correct Dr. Niemeyer's statement that the night air of large cities is less noxious than the stirred-up air of the day time, and he does so with a degree of confidence that seems to imply that there can be no such thing as doubting that he speaks *ex cathedra.*

Now, Dr. Black evidently believes the insalubrity of city air depends upon the amount of non-respirable gases that may be diffused into the respirable ones; and is wholly independent of the condensible effluvia of the vaporous kind, or of the organic germ-dust that the heat and stir of the day may keep suspended, but would settle with the cooling and quiet of the night.

Now, while the precise application of the law to cities has not been made before, perhaps, in your journal, the teaching which inevitably leads to it has been abundant, and from unquestionable authority, so that, if Dr. Black wishes to cor rect so fatal an error as he charges this to be, he is very late with his solicitude. One lecture of Tyndall's, published by you, devoted much detail to the experiments of the professor, in his attempts to bottle a sterilized infusion in the laboratory of the Royal Institution, in air he had attempted to sterilize there, and explaining that he did succeed in a special chamber elsewhere. If, as Dr. Black would imply, noxious effluvia obey the law of diffusion of permanent gases, how comes it that they specially hover over low marshes and putrefying cesspools, while the ascent of a mountain of considerable elevation carries us above malaria and aërial infection, and often above bacterial decay?

A recent experiment of Tyndall's was to sterilize a bottle of infusion and open it upon the brink of a precipice, and, after contact with the air, recork it, to observe whether the infusion retained its sterility or not. He found the air germless. The experiment was made to test this identical question of the settling of ferment-germs.

Pasteur tried similar experiments, ascending to high points in Paris, bottling and comparing the air so bottled in putrefactive power with the air bottled upon Mont Blanc, and with the air of the streets of Paris, always with the result of finding the air of the street levels more laden with micronymes than that obtained at considerable elevations. Upon the western plains, before civilization had scattered its filth, laden with zymogens, meats hung up in the air, even in midsummer, would keep sweet for days. The Emigrants in 1849, in crossing the plains, were surprised to find often the carcasses of dead animals of a previous caravan, drying up, viscera and all, without decay. This is easily explained on the germ theory; without, it is inexplicable. If Dr. Black has any evidence that the germ theory of decay and zymotic diseases is untenable, he should presently submit it, for, to my thinking, the world is only waiting to hear from Dr. Charlton Bastian, when the testimony and argument will be declared closed.

Respectfully, C. W. Johnson.

Atchison, Kansas, February 20, 1878.

EDUCATION.

CO-EDUCATION.

BY PROF. G. C. SWALLOW, UNIVERSITY OF MISSOURI.

The discussion of the co-education of the sexes has brought out some very remarkable facts respecting the girls in the wealthiest and most enlightened portions of our country—those parts including Boston and New York as centers. We are told, to prove the physical incapacity of girls for the higher co-education, that in the New York Normal College for girls, during two years, more than one-half of the pupils were daily absent, mostly from sickness; and "that it was no uncommon sight to see three or four young ladies carried out of the chapel in a fainting condition." If this is a fair representation of the physical condition of the New York girls—and if it is not, those publishing it have perpetrated a pitiful fraud—the civilization of that portion of the country is a miserable and criminal failure. If the women have so degenerated as to be incapable of five hours of school duties per day without incurring such fearful results, they surely must be wholly incapacitated for the duties, pleasures and honors of domestic life. If the mothers of a people have so little stamina as these facts indicate, the men as well as the women of the next generation must be wholly incapacitated for the first and highest duties of the race. These puny people must die out, and some stronger stock take their places. This result is as inevitable as the laws of nature. The Creator does not rely upon such debilitated women for the fulfillment of the glorious destinies of the human family.

But the fact that these abnormal girls of the New York Normal College cannot endure the hardships of school life does not prove that our normal girls cannot successfully compete with our young men for the collegiate honors of our highest schools. But it does prove that the New York Normal College—though not co-educating—is not a fit school for the girls who try to pursue their studies in it. Any school which cannot secure a daily attendance of one-half its pupils, and from whose chapel "three or four girls are commonly carried out in a fainting condition," must have some radical defect. Either the pupils need a hospital more than a school, or the school-room must be a pestiferous source of debility.

But we leave the New York authorities to settle the question and apply the remedy, assuring those so anxious about our co-educated girls that we do not propose to co-educate either boys or girls who need nursing more than educating. Nor do we propose to educate anybody in schools so unhealthy that three or four will be commonly "carried out in a fainting condition." So we protest that such facts from exclusive schools are arguments against such schools, rather than against co-educating schools. The facts simply prove that New York

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girls have not the physical ability to sustain themselves in the New York College *for girls only.* It would seem, therefore, to be the part of wisdom for their physicians to attend to their own sick patients, and not be so very solicitious about ours, who are in perfect health. If ipecac makes their patients sick, why not stop the nauseating drug, and not be so alarmed about the iron which makes ours so well. We fail to see the logic of the argument; we can not see why our well girls should take the ipecac which makes theirs so sick, unless we want them to be sick, too. If Drs. Clarke and Winsor could only find one co-educating school with "half the girls sick," and the other half "fainting" and "emotional," they might have an argument against the system.

If they would cure the evil they paint in such vivid colors, let them consult nature, put the boys and girls together, restore them to the companionship the Creator gave them; and I will venture the assertion the girls will so improve, the first year, that the absentees will be reduced one-half, and that not even one girl will be carried out in a fainting condition, and that all of them will be far less emotional.

Oh! but that won't do. "The girls are so emotional," especially "at a certain age." Yes, and so are boys, as well as girls, and even men and women, more emotional at all ages *when the sexes are separated.* The experience of monks and nuns, as well as school boys and school girls, prove this.

The sickening statistics of our lunatic asylums, and the startling facts which occasionally come from these exclusive institutions, should lead every parent and every educator to seek some more logical solution of the evil which is sapping the very foundations of our civilization. Volumes might be filled with quotations showing that exclusive education has aggravated rather than lessened the great cause of so much physical debility in the rising generation.

But why do not Drs. Winsor and Clarke give us the sanitary statistics of the co-educating schools they so much condemn? They have hundreds of them scattered all over the East, from the Potomac to the Aroostook. Many of these academies are among the oldest schools of the country, and have co-educated many generations of girls, who never dreamed they were too puny and emotional to sustain themselves in these mixed schools. Please give us the statistics of those schools which educated so many of our noble, gentle and loving mothers. Let us see whether the girls educated in them were so feeble that half of them staid at home daily, and whether the remainder were so emotional that fainting was a common event. The statistics of these venerable academies would be of some service in this discussion.

To enable those discussing this subject to arrive at the true result, I will state a few facts respecting these schools. I have had thirteen years' experience in these old co-educating schools, as pupil and teacher; but I never saw a single girl faint in any one of them. My registers, running through ten years in three of these co-educating schools, show less than three per cent. of absentees. They also show the girls as punctual as the boys, and that they stood quite as high in the scale of scholarship. I do not remember any trouble from emotional girls.

When a pupil in these schools, I found it very difficult to keep even with my beautiful classmates in Physics, Greek, Latin and English.

While waiting for these statistics of co-educating schools, we would suggest to those so solicitous about the girls in our mixed schools, that we will abolish them all when they show any such sad sacrifice of girls as they have reported in the New York Normal College *for girls only.* And, besides, when any of our co-educating schools report half its pupils on the sick list, and that as an average for two years, we will ask the Board of Health to examine its sanitary condition, and, if no remedy can be found, abate it as injurious to the public health; and, where "three or four girls are commonly carried out of one of them in a fainting condition," we will ask the humane to aid us in saving our girls from so cruel a system.

ARCHÆOLOGY.

TRACES OF SOLAR WORSHIP IN NORTH AMERICA.

BY EDWIN A. BARBER.

In an article published in the October NATURALIST, entitled "On the Ancient and Modern Pueblo Tribes of the Pacific Slope of the United States," the writer made use of the following expression: "Both paid homage to the sun, or at least looked for a Messiah daily to come to them from the east," to which assertion exceptions have been taken by some ethnologists.

It is held by this class of scientists that the heavenly bodies were never deified by any of the American races. Granting this to be, in some degree, true: That the luminaries, collectively or individually, were not elevated to the *highest* place in their worship, by any tribe or people in North America, yet the celestial orbs, nevertheless, figured prominently in the list of supreme objects of worship, and many *traces*, at least, of this form of worship are found in the religions of aboriginal races of all ages, from the oldest American people down to the tribes of the present day, especially among those versed in astrology or astronomy.

Although little is known of the Toltecs of Ancient Mexico, it is an established fact that astral worship existed among them. They paid homage to the sun and dedicated their earliest temples to him. The moon, also, they reverenced as his wife and the stars were believed to be his sisters, according to the Mexican Licentiate, Don Mariano Veytia, in his "*Historia Antigua.*" The same writer describes the ruins of San Juan Teotihuacan, the most ancient architectural remains of Mexico, situated about thirteen miles north-east of the capital city. Of these, the largest pyramid, which measured six hundred and eighty feet in length at the base and was estimated at two hundred and twenty feet in height, was dedicated to To-

natinh or Tonatricli, the sun ; the next structure in size and importance was inscribed to Meztli, the moon. On the summit of the former a temple was erected, in which was placed an immense statue representing the sun, which faced towards the east.

According to the accounts of Bernardino de Sahagun, a Spanish writer of the sixteenth century, and one who was particularly cautious in his deductions and entirely reliable in his accounts of the religion of the Aztecs, as set forth in his "Historia Universal de Nevua España," solar and lunar worship occurred in the Aztec religion, the sun with them being a spiritual conception. They believed that the heroes who fell in battle or died in captivity, or women who died in childbirth, were immediately transported into the House of the Sun, where they led a life of everlasting delight. From the broad tops of their *teocallis* or temples, the Aztec priests were in the habit of performing impressive, and, in too many cases, bloody ceremonies, in which the heavenly bodies were made to take a prominent part.

After the fall of the Mexican Empire, traces of sun worship were common. Captain Fernando Alarcon, in the year 1540, mentioned having met, on the Colorado river, Indians who worshipped the sun.

The same custom exists among the modern Pueblo Indians of New Mexico. Lieut. A. W. Whipple says of these people that "they are now anxiously expecting the arrival of Montezuma; and it is related that in *San Domingo* (one of the nineteen Pueblo towns), every morning at sunrise, a sentinel climbs to his house-top and looks eastward, to watch for his coming."

Mr. Whipple also gives a tradition[1] of these Indians which assigns *Acoti* (another Pueblo village, situated on the Rio Grande del Norte, the ancient Tiguex) as his birth-place; but the tale is so at variance with facts and so rich in imagination that it is evidently the invention of some fertile brain. The Spaniards who came among the Pueblos, just after the Mexican conquest, about the year 1539, evidently introduced the name of Montezuma and probably instilled into their minds this idea of his second advent. Thus the worship of heavenly bodies may have become blended with the deification of ancestors; then the sun may have taken the name of Montezuma. Whipple further states that they "smoke to the sun that he may send them antelope to kill, Indians to trade with, and save them from enemies."

Among the Navajos, also, by the same authority, "The sun, moon and stars are sacred, as the authors of seasons of rain and of harvest." He also says of the Zuñians, "Beneath the apparent multiplicity of gods, these Indians have a firm faith in the Deity, the unseen Spirit of God. His name is above all things sacred, and like Jehovah of the Jews, too holy to be spoken. Montezuma is His son and their king. The son, moon and stars are His works, worthy of their adoration."

The "ancient Pueblos" of the Pacific slope of the United States, whose ruined stone structures are found so numerously throughout portions of Colorado, Utah, New Mexico, Arizona, and probably Nevada, held the sun in high

[1] Vol. III, Pacific R. R. Reports.

esteem, at least, if they did not worship it. This is shown in the situation of the houses in many localities. In the Cañon of the Rio Mancos,[1] for example, the dwellings are almost invariably found secreted in the cliffs of the *western* bluff, and from their roofs the inhabitants were wont to salute the king of day as he raised himself above the eastern plateau.

Among the Moqui tribe, to-day, traces of this form of worship still obtain. The religion of their forefathers seems to have degenerated into a mere custom, the origin of which has been long lost sight of in their obscure traditions. Thus, in the course of time, it seems probable, the worship of celestial orbs has given place to hero-worship; solar worship to anthropomorphism, and it is said that the Moquis have ultimately become imbued with the belief that it is a Messiah, in the form of one of their own ancestors, that is, Montezuma,[2] whom they are expecting to arrive from the east. The Moquis and the Pueblos and Zuñis are cognate tribes and doubtless remnants of the ancient Nahuatlac races; hence the similarity of their customs.

As the faint streak of red lights up the low horizon, tall, dark figures appear on the parapets of the seven Moqui towns and remain facing the dawn until the sun has appeared entirely to view. Then the muffled forms drop away slowly and sadly, one by one, for another morn has brought disappointment to the souls of many that have watched so eagerly and persistently for the coming of the great Montezuma. The routine of another Moqui day has commenced; all is bustle and life and the subdued hum of household occupation floats out drowsily on the sullen, sultry air and the sound of the hundred flour-mills (*metates*) grinding steadily on every side, seems, as it issues from the doors and windows of the stone houses, to pause in mid-air like a droning bee. Then scores of busy figures repair with their water-vessels to the verge of the steep bluffs, and disappear in the crevices of the rocks below.

Having presented these facts in support of the assumption that solar adoration entered, to some extent, into the religions of some of the American races, we may sum them up briefly as follows:

1. Fetichism being the commonest form of idolatry, especially amongst the lower races of man, most tribes whose religion is polytheistic, venerate the sun.

2. We can detect vestiges of sun-worship in the ruins of the Toltec and Aztec temples and pyramids and also in the statues which were placed within them.

3. We can observe traces of it in the traditions and observances of savage and semi-civilized tribes at the present day.

4. We notice indications of it in the hieroglyphics or picture-writings of most North American tribes, ancient and modern, in which the sun symbol occurs frequently.

5. Also in the position of ruined stone houses which look toward the east, the larger rectangular buildings of the Pacific slope being built so as to face the cardinal points.

[1] A northern tributary of the Rio San Juan, in the extreme south-western corner of Colorado. [2] Motecuhzuma.

6. Finally, we can observe signs of this worship in the orientation of dead bodies in graves.

If we accept these briefly stated facts, there can be no reasonable doubt that the worship of the sun entered, to some degree, into the religions of the American aborigines; how far, we have not the means of determining; yet, quoting the poet Southey's words,—

> "I marvel not, O sun! that unto thee
> In adoration man should bow the knee,
> And pour the prayer of mingled awe and love;
> For like a god thou art, and on thy way
> Of glory sheddest, with benignant ray,
> Beauty, and life, and joyance from above."

—*American Naturalist.*

PREHISTORIC RUINS IN DADE COUNTY, MISSOURI.

To Mr. W. G. McDowell, we are indebted for the facts pertaining to a remarkable curiosity in Dade county, the existence of which, we understand, is unknown save to a few of our citizens. It lies near the edge of Connor's Prairie, about seven miles northwest of Greenfield, in section 29, township 32 of range 27 west, and about one hundred yards from the edge of the prairie, in the timber, and consists of a perfectly circular line of earthworks three hundred feet in diameter. The ground lies gently sloping to the south, where lies a small ravine shown

in the diagram. The northern arc consists of a single ditch and parapet, while the southern portion, overlooking the ravine, consists of two distinct and parallel lines of trenches and embankments of considerable strength, with a third inner line in the central portion, as shown by the cut. On the east and west sides of the enclosure are two openings or entrances in the walls, each about twenty feet across. Here the walls are doubled, the outer ones preserving the circular form, while the inner lines curve inwardly until the ends point to the center of the fortification. In the opening between the termini are situate two mounds, one at each entrance, almost filling the entrances. The walls are five or six feet wide, and though worn now by the rains of centuries, are from two to four feet in height.

In the enclosure is an old well, now partially filled with debris, from which the prehistoric warriors or priests undoubtedly obtained their supply of water.

The ground is covered with a growth of timber, and some large trees are standing on the embankments. That it was the work of a people whose history is unknown to us is evident; but for what purpose and by whom are idle speculations.

The subjoined diagram gives a very correct general idea of its appearance. The object is well worthy of a visit.—*Dade County Advocate.*

THE BLACKWATER, MISSOURI, MOUNDS.

The Warrensburg *News* has an account of the discoveries made by the Normal School students in the recently opened mounds on the Blackwater, near that place, from which we get the following:

The mounds are arranged in the form of a triangle, but are not all of the same size. The most northern one is the largest, and was the first one explored. It is about thirty-five feet in diameter at the base and about five feet high in the center. The vault is 7x13 feet, surrounded by a rude wall of thin limestone slabs, and covered by the same. In the vault were found the remains of seventeen human beings, arranged in two rows of eight each, and the odd one in the middle—the skulls being about one foot apart. The earth was so packed about them that it was difficult to secure bones in perfection, yet a number of jaws, thigh bones, etc., were saved.

About midway of the vault on the south side a pottery jar was found of a capacity of three quarts. The rim has an attempt at ornamentation. Around the neck is the remains of what was a copper band about an inch in width, while around the widest part, at the middle of the jar, is a two-inch band of thin silver. In the northwest corner a similar jar was found, but without the bands. There were also arrowheads, pieces of lead ore, paints, etc., found mixed with the bones, and at the west end were found several stone pipes, some of soapstone, others of bluish sandstone. One was about six inches in length, with the bowl, stem and holder all cut from one piece of stone. Some of the red paint is very soft, and when rubbed on the hand has a peculiar lustrous metallic appearance.

In the other mounds were found flint arrow heads, red ochre and other paints, and round pieces of flint, supposed to be for grinding purposes, and also good sized lumps of lead ore. The teeth in the jaws were all very sound. Several deer horns were also found, and had the appearance of having been used as implements, as daggers, or something of that nature.

The digging was done from the top downwards. The mounds are composed of rather a reddish clay, and is supposed to have been obtained from a locality away from the mounds—"as there are no streaks, layers or other evidence that it was scraped up or gathered from the surface round about. It was not mould."

These are the details as we find them in the *News*. The site of the mounds is upon a beautiful elevated spot, well drained in all directions, and from which a good view of the surrounding country could be had before the present growth of trees obscured it. This growth is of oak and hickory trees of fifty or sixty years' growth.—*Journal of Commerce.*

A QUARRY OF INDIAN RELICS.

A discovery that will prove of interest to antiquaries has been made in Johnston township, Providence County, R. I. The exact locality is about one hundred yards north of the Killingly Pike, on the Big Elm Farm. Mr. H. M. Angell, of Providence, whilst engaged in quarrying slate at the place above indicated, found a soapstone bed between two slate ledges, about six feet underground. Cartloads of pulverized stone were removed, without any suspicion that it was the debris of an ancient mine. At last the surface of the soapstone rock was reached, and this was so curiously carved as to attract the notice of the workmen, the entire surface being covered with hollows and projections. This was a rock from which the aborigines had carved soapstone dishes and utensils. The method was to cut away the stone from a circular portion till that was left as a projection, and then cut under the projection until it was detached, after which the block thus obtained was hollowed out and became a dish or bowl. The work has been done with knives and hammers of stone, the slate furnishing a sharp edge to cut, chisel and scoop out the soapstone. One of two stone hammers found weighs nearly one hundred pounds, and was hollowed in the middle, probably so as to be bound with thongs to a handle. Already one hundred and fifty cuttings for bowls that were never finished, have been counted in the soapstone. The ledge itself had been cut down by the aboriginal workmen, in its manufacture, several feet below the original level. Large numbers of stone hammers and axes have been found by the explorers. The rock is soft, and some copper, silver, talc and asbestos are associated with the soapstone.

METEOROLOGY.

THE VALUE OF SCIENTIFIC WEATHER OBSERVATIONS.

Three daily observations of weather phenomena are made at eighty-three stations of the Central Pacific and Southern Pacific Railroads and their branches, the area covered by the observations extending through eight degrees of latitude and twelve degrees of longitude. New observing stations are set up in proportion as a new line of road advances. The records of these stations form the basis of a singularly interesting and important paper by Mr. B. B. Redding, which was read at a meeting of the California Academy of Sciences on January 21st. In illustration of the *financial value* of systematic observations of this kind, the author gives two cases where even superficial study of the meteorological records would have demonstrated in advance the inevitable failure of certain enterprises. For instance, in 1869 a large sum of money was expended in covering over some lakes near Summit Station with sheds, under which to cut ice for the San Francisco market.

No sheds of sufficient width could be built that could bear the weight of snow falling at that point, and consequently the undertaking ended in disastrous failure. The meteorological records of the railroad companies show that the average rainfall at this point is over *five feet!* "Nearly all of this falls in the form of snow, and is equal, if the snow that falls did not become compact or melt, to a bank of snow each winter of sixty feet in depth." A similar instance of the value of these records is furnished by the experience of the farmers settled on the west side of the San Joachin river. For years they have tried in vain to raise crops without artificial irrigation. That section of the State of California is an exemplification of the law thus expressed by Guyot, that "when a mountain chain opposes an horizontal wind the air is forced up along the slopes, its vapors are condensed and water the side exposed to the wind, while on the opposite slope the same wind descends into the valley dry and cloudless." The author considers very fully the operation of the chief laws of meteorology as applied to California in general, and to special localities in particular. Among the subjects discussed by him, we would mention the conflict between polar and equatorial winds; the influences of the Gulf of California; the comparative rainlessness of the Colorado and Mohave deserts and the Tulare Valley; the rainfall in the great valleys and on the mountain sides; the influence of the great deserts on temperature and rainfall; why the summer temperature of San Francisco is so low as it is, the mean temperature of summer at the Golden Gate being only 56°.—*Popular Science Monthly.*

KANSAS WEATHER REPORT FOR MARCH, 1878.

PREPARED BY PROF. F. H. SNOW, OF THE STATE UNIVERSITY.

STATION—Lawrence, Kansas. Latitude, 38 degrees, 57 minutes, 25 seconds; longitude, 95 degrees, 16 minutes; elevation of barometer and thermometer, 875 feet above the sea level, and five feet above the ground; rain guage on the ground; anemometer, 105 feet above ground, on the dome of the University building, 1,200 feet above the sea level.

The warmest March since 1868.

Mean temperature 50°.9, which is 10°.86 above the average March temperature for the ten preceeding years. Highest temperature, 81°, on the 23d; lowest, 27° on the 4th; range of temperature, 54°. Mean at 7 a. m.; 44°.34; at 2 p. m., 60°.06; at 9 p. m., 49°.64. There were but four frosts during the month, all of which were very light and caused no damage to fruit Peaches were in blossom on the 15th, cherries and pears on the 25th.

Rainfall, 2.67 inches, which is 0.14 inches above the March average. Rain fell on eight days; there were a few flakes of snow with the rain of the 29th. The entire depth of snow for the season 1877–78 has been but three inches; the smallest amount on our ten years record.

Wind—S. W., 31 times, N. W., 26 times; S. E., 11 times; N. E., 8 times; E., 6 times; S., 5 times; N., 3 times; W., twice; calm once. The entire distance travelled by the wind was 11,994 miles, which gives a mean daily velocity of 387 miles, and a mean hourly velocity of 16.12 miles. The highest velocity was 50 miles an hour, on the 28th.

Mean height of barometer column, 29.005 inches; at 7 a. m., 29 025 in.; at 2 p. m., 28.982 in.; at 9 p. m, 29.008 in.; maximum, 29.372 in., on the 17th; minimum, 28.519 in.; monthly range, 0.853 in.

The following is a copy of a portion of the daily record of temperature, direction and velocity of wind, face of sky, humidity and rainfall:

Date.	Temperature. 7 a. m.	2 p. m.	9 p. m.	Mean.	Direction of Wind.	Miles of Wind.	Face of Sky.	Mean hu'dity'	Rainfall in inches.
1	44 0	50.5	44.0	45.6	N E	394	cloudy	93.3	1.10
2	42.0	42.5	38.5	40.3	N W	505	cloudy	91.2	0.05
3	34.0	47.5	33.0	36.8	S W	505	clear	65.6	——
4	27.5	53.0	46.0	46.1	S W	707	clear	68.6	——
5	48.5	66.5	48.0	52.7	S W	646	half clear	49.5	——
6	49.5	65.5	48.0	52.7	W	242	clear	55.3	——
7	46.5	69.0	63.0	60.5	S W	303	half clear	2.1	0.55
8	61.5	50.3	47.5	51.7	S	919	cloudy	87.0	——
9	48.5	57.0	47.0	49.8	S E	686	clear	79.0	——
10	38.0	55.0	44.0	45.3	S W	343	clear	70.1	——
11	38.0	64.5	55.5	53.3	S W	132	half clear	62.4	0.10
12	45.0	55.5	45.0	47.6	N W	333	clear	70.4	——
13	40.5	2.5	44.0	45.1	N W	333	clear	64.9	——
14	35.0	57.0	46.0	46.0	N W	222	clear	7.6	——
15	43.0	71.5	57.5	57.3	S W	232	clear	60.6	——
16	44.5	59.5	16.0	49 0	N W	464	clear	61.3	——
17	40.0	57.5	46.0	47.3	N W	202	clear	62.7	——
18	40.5	59.5	52.0	51.0	E	262	half clear	60.9	0.01
19	47.0	77.0	65.0	63.5	S W	313	clear	53.2	——
20	51.5	76.5	60.0	62.0	S W	212	clear	63.3	0.01
21	55.0	63.0	55.0	57.0	var.	222	half clear	72.2	——
22	52.0	67.0	57.0	58 2	E	131	half clear	71.3	——
23	52.0	80.0	64.0	65.0	S W	253	clear	54.1	——
24	44.0	59.5	46.0	48.8	N W	444	clear	63.8	——
25	41.0	65.0	55.0	54.	S E	202	half clear	56.4	——
26	57.5	79.0	64.5	66.3	S W	606	cloudy	61.9	0.05
27	56.0	66.0	48.5	54.7	N E	363	cloudy	76.2	——
28	41.0	63 0	44.0	45.5	N E	707	clear	59.3	——
29	40.0	38.0	30.0	39.0	E	454	cloudy	92.4	0.85
30	37.0	47.0	42.0	42.0	N W	575	half clear	70 2	——
31	35.0	56.0	48.0	46.7	S E	212	half clear	65.2	——

ST. LOUIS METEOROLOGICAL SUMMARY FOR MARCH, 1878.

REPORTED BY WM. FINN, SIGNAL SERVICE U. S. A.

In general: Number of clear days, 13; fair, 9; cloudy, 9; number of days on which rain fell, 13; there were three thunder showers—on the 6th, 12th and 27th, the latter being a succession of heavy showers. A light frost was observed on the morning of the 25th. From the 19th to the 27th the weather was unusually hazy for the season.

Pressure of the air: Highest barometer, 30.285, on the 18th; lowest, 29.404, on the 27th; monthly mean, 29.923; the mean is unusually low, being more than a tenth of an inch lower than the average for March.

Temperature: Highest thermometer, 76°, on the 23d and 26th; lowest, 34°, on the 4th; greatest daily range, 30°, on the 26th; least daily range, 7°, on the 9th; mean of maximum temperatures, 62.6°; mean of minimum temperatures, 46°; mean temperature for the month, 54.2°. There were only five days in the month on which the temperature fell below 40°.

The following table shows the comparative extreme and mean temperatures of March for the years given:

	HIGHEST.	LOWEST.	MEAN.
1871	—	—	50.0°
1872	—	—	39.1°
1873	71°	8°	42.4°
1874	77°	19°	43.1°
1875	79°	12°	40.0°
1876	76°	8°	39.9°
1877	76°	9°	38.6°
1878	76°	34°	54.2°

It will be seen from this that the mean temperature of this month shows the abnormal excess of 12½° above the average.

Rain-fall: The total amount of rain-fall for the month is 2.79 inches, two-thirds of which fell in the first twelve days, and the remainder in the last five. There is a deficiency of nearly three quarters of an inch as compared with the previous seven years. The following is the comparative precipitation in March for eight years: 1871, 1.31 inches; 1872, 2.43 inches; 1873, 2.10 inches; 1874, 4.36 inches; 1875, 4.08 inches; 1876, 6.90 inches; 1877, 3.41 inches, 1878, 2.79 inches.

The wind: Prevailing direction, south; highest velocity, forty miles an hour, from southeast to southwest, on the 8th and 12th respectively; total movement of air for the month, 8,957 miles; mean velocity, 12 miles an hour; south to east winds preceeded rain.

The rivers; Highest stage of water during the month, 22 feet 10 inches, on 12th; lowest, 14 feet, on the 28th and 29th.

THE development of State systems of meteorology seems to make steady progress, as we have received the first monthly report of the Missouri weather Service, organized by Professor F. E. Nipher, under the auspices of the Washington Uni-

versity at St. Louis. The present number of voluntary observers is sixty-five, and it is hoped that at least one in each county will be secured. At the central station Professor Nipher possesses the Dellmann electrometer, used by Dr. Wisliczenus during the past fifteen years, and will soon take up a series of observations on atmospheric electricity, in continuation of those so faithfully made by that observer. It is to be hoped that Professor Nipher's labors will meet with a recognition as generous as his service is hearty and cordial.—*Harpers' Monthly.*

MINERALOGY.

SONOROUS SAND.

DR. JAMES BLAKE.

A short time since Mr. W. R. Frink sent from the Island of Hawaii of the Hawaiian group, to the California Academy of Sciences, a bottle of sand which possesses some peculiar qualities. A sand drift exists there some sixty feet high, and by taking two handsfull of this sand and slapping it together a sound is produced like the low hooting of an owl—more or less sharp as the motion is quick or slow. At the time of the receipt of this sand we gave a description of its peculiarities as detailed in a letter accompanying the gift :

" The bank, which is composed of this sand, commences at a perpendicular bluff at the southwest end of the island, and extends one and a half miles almost due south, parallel with the beach, which is about one hundred yards distant from the base of the sand bank. This sand drift is about sixty feet high, and at the extreme south end the angle preserved is as steep as the nature of the sand will permit. The bank is constantly extending to the south. It is said by the natives that at the bluff and along the middle of the bank, the sand is not sonorous. Sit down upon the sand and give one hand a quick circular motion, and the sound is like the heavy base of a melodeon. Kneel upon the steep incline, extend the two hands and clasp as much sand as possible, slide rapidly down, carrying as much sand as possible, and the sound accumulates as you descend, until it is like distant thunder. In this experiment the sound was sufficient to frighten our horses, fastened a short distance from the base of the drift.

" But the greatest sound we produced was by having one native lie upon his belly and another taking him by the feet and dragging him rapidly down the incline, carrying as much sand as possible with them. With this experiment the sound was terrific, and could have been heard many hundred yards distant. With all the experiments that were made, it seemed the sound was in proportion to the amount of sand put in motion with a proportionate velocity. Another consideration seems requisite, that is, its perfect dryness. The dry sand would sound on

the surface, where six inches beneath it was wet; but if any of the wet sand becomes mingled with the dry, its property of sounding ceased at once. The sand appears to the eye like ordinary beach sand, but ordinary beach sand will not produce the sounds. It has been said that it lost its sonorous properties when taken away from the bank. But I can discover no diminishing of its sonorous qualities, even with the bottle uncorked, and we have had rain frequently, and an atmosphere more than ordinarily moist for this time of year. Perhaps if exposed to a very damp atmosphere it might absorb moisture enough to prevent its sounding."

In order to ascertain, if possible, the cause of the sound produced by this sand, Dr. James Blake has investigated its structure under the microscope, and at the last meeting of the Academy of Sciences, he stated that the facts he had ascertained fully explain the manner in which the sound is emitted. As the grains of sand, though small, are quite opaque, it was necessary to prepare them so that they should be sufficiently transparent to render their structure visible. This was done by fastening them to a glass slide and grinding down until one surface was obtained. This surface was then attached to another slide, and the original slide being removed the sand was again ground down until sufficiently transparent. The grains were found to be chiefly composed of small portions of coral, and apparently calcareous sponges, and presented, under the microscope, a most interesting object. They were all more or less perforated with small holes, in some instances forming tubes, but mostly terminating in blind cavities which were frequently enlarged in the interior of the grains, communicating with the surface by a small opening. Several specimens of what appeared to be minute bi-valve shells were also met with. Besides the elements derived evidently from living beings, these sands contained small, black particles which the microscope showed to be formed principally of crystals of augite, nepheline and magnetic oxide of iron, imbedded in a glossy matrix. These were undoubtedly volcanic sand.

It would be impossible to give more than a general idea of the appearance of this sand under the microscope, except with elaborate drawings. The structure of the grains, Dr. Blake thinks, fully explains the reason why sound is emitted when they are set in motion. The friction against each other causes vibration in their substance, and consequently in the sides of the cavities they contain, and these vibrations being communicated to the air in the cavities, under the most favorable conditions for producing sound, the result is the loud noise which is caused when any large mass of sand is set in motion. There are in fact millions upon millions of resonant cavities, each giving out a sound which may well swell up to resemble a peal of thunder, with which it has been compared, and the comparison, Dr. Blake knows from those who have heard it, is not exaggerated. The effect of rain or dampness in preventing this sound, is owing to the cavities in the sand becoming filled with water and thus rendered incapable of originating vibrations. The chemical composition of the sand, with the exception of the volcanic grains, is calcareous, being completely dissolved by chlorohydric acid, although it is probable that some of the spiculæ in the sponges are silicious.—*Naturalist's Bulletin.*

DIVISIBILITY OF GOLD.

At a recent meeting of the California State Geological Society, Mr. Henry G. Hanks read the following paper on this subject:

Having recently had occasion to refer to statistics showing that gold coin loses an appreciable amount even in a single handling, and being desirous, in connection with my investigations, to examine microscopically the gold dust resulting from such abrasions, I asked Mr. L. A. Boynton, of the United States Treasury, of this city, to brush out the wooden tray in which large sums of gold coin are daily handled, and when he had accumulated sufficient to see the gold, to send it to me. He kindly complied with my request, and I am able this evening to call your attention to some interesting facts, which have developed themselves in the examination.

I have prepared a slide for the society's collection, in which the gold is mounted dry, after first partly removing the impurities with which it was mixed. It will be seen, however, that there still remain coal, sand, fibers of wood and cotton, hairs, etc. In washing out the extraneous matter, the finer particles of gold floated on the surface of the water, and I found it impossible to cause them to sink, although I tried every plan I knew of. This experiment would seem to prove the truth of the oft-repeated statement of miners, that much free gold escapes them from this cause.

On examining the slide under the microscope, it will be seen that the gold is invariably in the form of scales, and much resembles the natural gold scales found on the beach sands at Cape Blanco, except that in the latter the edges and face of the scales are rounded by attrition in being washed about by the waves.

It has been a source of wonder to gold miners that nearly all placer gold is found in flat places. Some ingenious brain theories have been advanced to account for it. The sample I present this evening would seem to indicate some law which governs the form of fragments. I admit I cannot clearly understand how rounded masses of metal like gold coin should react on each other mechanically and produce flat fragments, as shown in the specimen.

To give an idea of the size of the particles of gold, I have measured some of them in decimals of an inch, and I find them to vary from .003x.001 to .0425 x.0235.

I have also measured a large number of the gold scales from Port Orford, and find an average of .0095 in diameter by .00384 in thickness.

The samples were washed from the beach sands found a few miles south of Cape Blanco, on the coast of Oregon. Ten of the scales, selected at random, and melted into a button, weighed .0021327 grammes. From this weight I have calculated the number of such scales which would be required to make up the weight of an ounce troy.

If I have made no mistake in my figures, the number should be 142,468, and yet these gold particles are large as compared with those usually found in quartz.

In collectiong gold from quartz by amalgamation, it has been found that, in most parts of California, any mine producing rock that will yield, by simply milling process, $10 to the ton of 2,000 pounds, and in sufficient quantity to keep a mill constantly running, will pay well to work.

Most of the best paying mines in California do not produce rock in which gold is visible to the naked eye. It requires long search to find a piece of rock showing free gold.

When the tailings of a quartz mill are examined microscopically, the importance of reducing the ore to a state of extreme fineness will be apparent, for if gold is not absolutely free it cannot be collected by mercury.

Recent investigation naturally leads to the opinion that gold in a state of extreme division is omnipresent in the earth's crust. T. Sterry Hunt, in his work, "Chemical and Geological Essays," quotes Sonstadt to show that the sea water on the British coast contains, besides silver, gold in solution, estimated by him to be about one grain to a ton of water. Mr. J. Cosmo Newberry, Chemist of the Geological Survey of Victoria, Australia, has made some very interesting investigations bearing on the divisibility of gold. He found that the water in certain gold mines contained gold. The timber used to support the mine was carefully assayed and in nearly every case was found to contain gold. R. Brough Smyth, Chief of the Survey, came to the conclusion that the gold was precipitated from solution.

Mr. Newberry had reason to believe, from examination of specimens, that gold was being deposited in many mines. He thinks, however, that finely divided gold is held in suspension in mine water, but not in solution. A sample of mud deposited from mine water of a mine, on Hasler's line of reef, Sandhurst, was examined by careful washing, and the heavier particles were found to consist of auriferous pyrites and free gold. The particles of gold were large enough to be recognized by the microscope. They were in irregular flattened grains.

Dr. Oxland, who was formerly Manager of the Borax Lake Company's works, has given a very interesting account of the deposition of gold with cinnabar, free mercury, sulphur, boracic acid, silica, etc., at the sulphur banks situated on the margin of Clear Lake.

He says: "These phenomena present indubitable evidence of the volatility of gold and silver, mercury and iron, in presence of aqueous vapor, associated with sulphureted hydrogen, carbonic acid and boracic acid."

Some years ago, in Calaveras county, an old furnace—used in roasting pyrites preparatory to treatment by chlorination—was torn down, and the roof was found to be coated with cold. A specimen is preserved in the museum of the University of California. Here is proof that gold is volatile at a comparatively low temperature. It has long been known that it is volatile at a high temperature, and advantage is taken of this fact in the purification of platinum.

On the Pacific coast, gold is found in the most unexpected places. There is scarcely a formation which does not contain gold in greater or less quantities. It is also found associated with minerals not usually considered its associates.

To illustrate this fact, I have brought, for inspection, several remarkable specimens:

1. Gold in pyrolusite.

2. Gold in steatite.

3. Gold in calcite. In this specimen the gold is deposited on the wall-rock of the mine, apparently by the same agencies which deposited the calcite.

4. Gold on pyrites. It will be remembered that I exhibited a similar specimen at a former meeting, and called attention to the globules of gold, which seemed to be squeezed out of the crystals of pyrites, or to have been deposited on their surfaces in a manner not easily explained. The specimen I have brought this evening is more remarkable than those formerly shown.

I have long believed that the gold in sylvanite, nagyagite, calverite and other telluric minerals was a mechanical mixture and not chemically combined. Experiments I have made from time to time have convinced me that my opinion was correct. I have prepared a specimen of telluric gold, from Sunshine, Colorado, which is worthy of your attention. You see that the gold is in a state which would preclude the idea that it had been chemically combined with the tellurium, in which case the gold would have been an amorphous powder rather than the semi-crystalline form shown. The specimen has been repeatedly boiled in nitric acid, by which the tellurium has been dissolved.

It must be admitted, from the experience of the last twenty-five years, that gold exists in minute quantities in many rock formations which will not pay to work. On the other hand, many mines, which will scarcely pay at the present time, will become productive as our quartz milling machinery is improved. Much gold is lost in California by unskillful milling.

Although the modern quartz-mill is a marvel of mechanical skill and ingenuity and does its work rapidly and well, yet it has not reached perfection. The problem for the future inventor to solve will be to construct machinery which will reduce the rock to an impalpable powder, to set the gold free and to collect it without mechanical loss of either gold or mercury.—*Sci. Amer. Supp.*

THE FUTURE OF LEAD.

Below we give an extract from the *Engineering and Mining Journal*, of New York, which has some good points in it, but which does not, in our judgement, touch the case in its vital point. Instead of depending alone upon the reduction of the cost of producing and transporting lead as the means of making it profitable to the miner, we must devote ourselves to discovering new uses for this metal. At present it is used principally in the manufacture of paint and of tubing, and for such purposes the demand is exceeded by the supply. A large number of economic uses in building and in the arts may be better subserved by this almost indestructible metal, and the proper degree of attention turned in such directions will avail more in raising the price to a paying point than either the

first named means on the one hand, or passing resolutions and getting up "corners" on the other.

THE PIG LEAD COMBINATION.

"Sales of about 200 tons at $3.75@$3.80 have been made during the week. The market is for the moment higher, being quoted at about $3.85. The cause of this is not on the surface. There is still a large stock held in numerous hands, and although undoubtedly there must come a better demand for the article than prevails now, yet there is nothing to indicate that the production will be less than the consumption. In fact, the indications are that the production this year, like that of 1877, will be greatly in excess of the requirements.

The shipments of pig lead from England to China for the first two months of this year were 1,410 tons, as compared with 2,640 tons last year, and to Japan 572 tons, as against 31 tons for January and February, 1877.

A number of estimable gentlemen who reside at or near St. Louis seem to imagine, as we have several times had occasion to report in these columns, that, by a stroke of the pen, they can regulate the price of lead for the whole United States. They have held meetings and agreed among themselves that the present price of lead is outrageous, and that there is no valid reason why—if they would all say so together—they should not make consumers and dealers everywhere actually believe that lead is not so abundant as they thought it was, and persuade them to pay more for it.

We have before us a circular issued by these gentlemen on March 9, in which they state that they have formed themselves into an "*American Pig-Lead Association*," and they ask all dealers or producers of lead to join the same, and pay for this privilege twenty-five dollars each.

The members who sign the articles of the association bind themselves—under penalty of being turned out of the A. P. L. Association—to sell no lead at a less price than that fixed by the Executive Committee of said association.

Provided, that the lowest cash price for first class corroding lead shall not be less than four cents per pound in New York and that less freight to New York and other points. Other than first class corroding lead to be 15 cents per hundred pounds less than this. The committee to fix prices on the 15th of each month for the succeeding month, and to notify each member of the A. P. L. A.

Provided, that this agreement shall be signed by all producers in the United States who produce annually as much as one hundred tons of lead, and by all persons now holding as much as one hundred tons of lead otherwise than as manufacturers or consumers.

Each member is to consider a notice from the Committee that this agreement has been sufficiently signed, as sufficient, and thereafter he is to do no business below the official rate—or if he does, the Executive Committee will "investigate" him, and expel him from the association.

Any member may withdraw on giving thirty days' notice.

This movement—which is a very faint imitation of the Anthracite Coal Combination—will never pass beyond the stage of a meeting "resolution." The fact is apparent to all outside of St. Louis who have studied the question, that the limi

to the decline in lead will only be found when we find foreign market for our surplus, and no amount of combination can advance prices here till that has been secured. The gentlemen who have "resolved" so many things according to this circular, had better resolve to secure greater economy in production and transportation, and carry into effect the only sensible resolution passed at the meeting referred to, viz: "to investigate the question of immediate exportation of the lead to China and elsewhere." We have reason to believe that some of the largest Missouri works can produce lead at 1¾ cents per pound, and are expecting to make further economy. This of course does not leave profit to the works, but it is sufficient to show that even when the export figure (from 3¼ to 3½c.) is reached, Missouri can still maintain its own in the struggle for the prize.

The rapidly increasing production of argentiferous bullion in Utah, Colorado and Nevada, where the ore is treated for its silver alone, and where the silver is made to pay, in part or altogether, the freight on the lead to St Louis, and even to New York, is an element in the lead market which cannot be controlled by any combination, and which has to be met in a more practical form than a set of resolutions decreeing on paper a minimum price for lead.

This, indeed, seems to us to be the very key to the lead question, and it is pure folly to ignore or belittle it."

INDUSTRIAL NOTES AND MISCELLANY.

SEASONABLE HINTS FOR AMATEUR GARDENERS.

FLOWERS.

This is the month to pay attention to the hardy annuals. The sooner they are sown the finer they will flower; that is, provided they are really hardy. Tender annuals, such as Globe amaranthus, Balsams, &c., rot if they are sown before the weather becomes quite warm. The seedsmen's catalogues usually distinguish these classes for their customers. In sowing annuals the soil should be slightly stirred with a broad-bladed knife or trowel; and after the seeds are sown they should have a little soil sprinkled over them, about one-sixth of an inch deep, according to the size of the seeds; barely enough to cover is all that is required. Failures usually arise from the seeds being buried too deeply. Failures also frequently occur from the soil with which the seeds are covered being too stiff or clayey, "baking" after a rain. Light sandy earth or decayed vegetable loam from the woods should be employed for the purpose. Stick a peg in where the seeds are sown, so that when turning out the plants in May from pots, the annuals will not be disturbed. Also take care to preserve the names of the kinds. This is a great part of the interest in the flower garden.

Walks should now have their spring dressing—the verges cut, and a thin coating of new gravel laid on. Before putting on the new, harrow up the face of the old gravel with a strong iron toothed rake. Roll well after the new is laid on.

This is the proper season to lay down box-edgings. To make them properly the soil along the line of the edge should be first dug, and then trod very hard and firm, so that it may sink evenly together, or the line will present ugly looking undulations in time. Rooted plants should be employed; cuttings are sometimes used but frequently die out in patches; a good edge can rarely be made from them. The plants should set pretty low down, leaving the plants, when set, one or two inches above the soil, according to their stockiness. Sometimes box edgeings are laid around beds formed in grasses. When so, a few inches of clear ground should be kept clean between the grass and the box, or the weeds will be so intermixed with the box, after awhile, as to render it a nuisance.

Herbaceous plants do badly if several years in one place. Every second year, at this season, take up and divide them. Sow as soon as possible some hardy annuals. The earlier they are in the ground after the frost leaves it, the finer they bloom.

Ornamental hedges judiciously introduced into a small place, add greatly to its interest. No easier method offers whereby to make two acres of garden out of one in the surveyor's draught. The arbor-vitæ (Chinese and American), Hemlock, Holly, Beech, Hornbeam, Pyrus japonica, Privet and Buckthorn may be applied to this purpose.

Shrubs are not nearly enough employed in planting small places. By a judicious selection a place may be had in a blooming state all the year; and they, besides, give it a greater interest by their variety, than is obtained by the too frequent error of filling it up with but two or three forest trees of gigantic growth. Plant thickly at first, to give the place a finished appearance, and thin out as they grow older. Masses of shrubs have a fine effect on a small place. The center of such masses should be filled with evergreen shrubs, to prevent a naked appearance in the winter season.

Many things that appear frosted a little at the tops should be severely cut down; it will prevent disappointment in the end. Shoots that are injured in winter—especially in the case of the rose—will often have sufficient vigor left to enable them to put forth leaves, and sometimes even go so far as to attempt to flower, then die off suddenly under the first hot sun.

FRUITS.

Grape-vines on arbors and trellises, should have their pruning finished before warm Spring days set in; or they will bleed. It does not injure them much but it looks bad. The pruning must be regulated by the condition of the vine. If the vines are young and the shoots weak, cut them all back, to make a new and vigorous growth. If already a fair quantity of strong shoots of last season's growth exists, cut out the weaker ones, so as to leave enough of stronger ones. The cane system, slightly modified, is best for arbors and trellises in the hands of

amateurs generally. This implies a new set of canes every year or two. If, as frequently happens from bad management, all the young and strong-bearing wood exists only at the end of the vine,—and these latter have become nothing but long, ropy-looking apologies for what a vine should be—the whole cane may be buried down in the soil to where the strong shoots spring from, and the young wood of last season trained up from this. The plant will then recover its good appearance quite as well as from cutting down, with the advantage of not sacrificing a year's crop of fruit.

Many kinds of raspberries, especially in dry soils, have a tendency to throw up innumerable suckers. These should be thinned out. Three or four canes are enough to leave in a "hill." We like, however, to grow raspberries in rows, where each cane may have a chance to enjoy an independent existence of about a square foot of soil for itself.

We have before remarked that fruit trees and bushes should invariably be cut in severely, and not allowed to bear the same season of planting. It is a fatal mistake to look for fruit the same season of setting out the trees. This is at the expense of future growth, and without future growth there will no future crops.

Raspberries, blackberries, &c., frequently bear and die when so treated. The canes should be cut back to a few inches on transplanting. Raspberries for fruit in fall should always be pretty well cut back. It is not essential with the regular Fall-bearing kinds, but it aids them much.

VEGETABLES.

In the garden we might give a hint in asparagus culture, that if very large stalks are desired the soil must be very rich, and the plants set as wide apart as rows of corn. It is to be observed that those who believe there are some varieties of asparagus that may be reproduced from seed, urge the necessity of planting very wide apart. We do not know that *very* large stalks are especially desirable, and for ordinary use would set the plants about twenty inches apart; about four inches beneath the surface is deep enough to set. Good deep soil is *generally* good; but if in a stiff soil, deepening it for asparagus only makes a *well* into which the surrounding waters drain. It is much better in such situations to plant in raised beds. The alleys between, then serve as surface ditches. Many failures in planting asparagus, arise from this depth of bed, under such circumstances. The plants rot from water about them.

In the open ground Peas and Potatoes receive the first attention. Then Beets and Carrots. Then Lettuce, Radish, Spinach, Onions, Leeks and Parsley. Beyond this, unless in some more favorable latitudes than Pennsylvania, little can be done till the first week in April. There is nothing gained in working soil until it has become warm and dry.

Those who have no Spinach sown in the Fall should do that right away; no amount of stable manure but will be a benefit to it, though guano, in even smallish doses, will kill it. Guano produces excellent Cabbage, mixed with the ground while it is being dug for that crop. Cabbage is ready; and Potatoes are better in

before the beginning of next month, if the ground is not too wet; many plant Cabbage between the Potato rows.

Onions are better put in early, but the ground ought to be dry, and trodden or beaten firm when the sets are planted; the ground ought not to have rank manure—wood ashes and pure undunged loam will alone produce an excellent crop.

To have Turnips good in Spring they must be sown very early; they are hardy, and must be put in as soon as the ground can be caught right.

Parsley delights in a rich gravelly loam, and should be sown very early.

Parsnips, another crop which should receive early attention, also delight in a deep gravelly soil, but detest rank manure.

Lettuce and Radishes continue to sow at intervals.

Herbs of all kinds are best attended to at this season—a good collection is a good thing.

The Carrot will thrive in soil similar to the Beet; lime is an excellent manure for it—we use Long Orange. Celery may be sown about the end of the month, in a bed of very light rich soil, and Tomatoes, Egg Plants and Peppers sown in pots or boxes, and forwarded. It is as bad to be too early with these as too late, as they become stunted.

In vegetable garden culture it must be remembered that we have to operate the reverse of fruit culture. A woody growth is what we require for fruit trees; but we need for vegetables a soft, spongy, succulent character, the very reverse of this. For this end the ground cannot be too deep, too rich, or too much cultivated. The hoe and the rake should be kept continually going, loosening the surface and admitting "air and light," as the old books used to say. There is not only an advantage in this for the direct benefit of the plant, but an early use of these tools keeps down the weeds, and thus we save labor. It is a great thing to be "forehanded" in the weed war.—*Gardener's Monthly.*

Apples for Missouri.—A correspondent, evidently of great experience, from Caldwell county, tells the *Rural World:* "If I were to plant out a new orchard of 100 trees, I would make it about as follows: 50 Ben Davis, 10 Lawver, 10 Winesap, 10 Jeneton, 3 Red June, 3 Early Harvest, 5 Maiden Blush, 3 Smith's Cider, 3 Bellflower, 3 Tallman Sweet. For an orchard of 200 trees, I would add 75 Ben Davis, 10 Rome Beauty, 10 Lawver, and 5 Red Astrachan to the above list. For an orchard of 1,000 trees, I would begin with 750 Ben Davis, and the balance in Lawvers, Jenetons, Winesap, etc."

PROGRESS OF PHOTOGRAPHY.

The second of the course of lectures before the Academy of Sciences was delivered last evening, in Association Hall, by Prof. C. F. Chandler, before a large and appreciative audience. The subject of the lecture was "Photography," and Prof. Chandler, in describing the early history of the art, said photog-

raphy is the act of producing pictures by the aid of light acting upon chemically prepared substances. The name is unfortunate, as it is not the light or the luminiferous principle of the sunshine which accomplishes the result. The proper name would be heliography, or sun writing, which was applied by Niepce to the process he invented in 1827, as more proper, but which has not been generally adopted.

The action of the sunlight in effecting chemical changes such as vegetable colors was noticed at a very early day, and it is a well-known fact that it is to the chemical rays of the sunlight that every leaf and blade of grass owes its chemical activity—which enables it to feed upon the water, the ammonia and salts, and elaborate in the great laboratory of nature the vegetable as well as the innumerable other principles which are to serve as food for the animals, and, after their being assimilated and organized into animal tissue, are to give out the power or force which they derive from the sun, which appears in every motion and every involuntary and voluntary act of the animals. If it is true, as has been stated, that the Egyptians employed an indelible ink prepared with nitrate of silver in marking their mummy cases, they must have been fully acquainted with the effect of sunlight in blackening silver salts in contact with chemical matters. Dr. J. M. Hooper, in his "Rational Recreations," published in 1774, gives a method of writing on glass by the rays of the sun with silver salts, employing a proper stencil for the purpose. Dr. Hooper attributes this experiment to Priestley. In 1777 Scheele called attention to the effect of light upon silver salts, and exposed a paper coated with nitrate of silver to the solar spectrum obtained by passing a beam of light through a prism. He found that the action was confined to the blue end of the spectrum, and that it appeared even beyond the yellow, beyond the visible spectrum, while no change took place in the green, the yellow, orange and red portion of the spectrum, thus demonstrating the fact that the rays which produce chemical decomposition were not identical with the luminiferous rays, and that they are most abundant at the more refrangible end of the spectrum. It has been claimed that Matthew Boulton and his partner, James Watt, actually obtained sun pictures at their works in Soho, near London, as early as 1799—perhaps even before 1791; but the evidence is somewhat uncertain.

THE FIRST IMPERFECT SUN PICTURE.

The first well-authenticated attempts to produce pictures by means of the sunlight were made in 1802 by Thomas Wedgewood and Sir Humphrey Davy. They moistened paper with nitrate of silver and exposed it to the sunlight under leaves and openings of glass such as are used in magic lanterns. They even took profiles. Davy succeeded in obtaining pictures with the solar microscope, but neither of these chemists was able to prevent the unchanged portions of the pictures from becoming colored when they were exposed to the diffused light; consequently their pictures were preserved in dark closets and examined with the aid of a candle. In 1814 Joseph Nicephore Niepce, of Chalons, studied the action of light upon asphaltum and other resinous bodies. He coated metallic plates

with asphaltum, and then exposed the image in the camera obscura. The asphaltum was rendered insoluble by strong lights, while in the shaded parts of the surface it retained its solubility. By washing it with oil of lavender the unchanged asphaltum was removed, and the metallic surface exposed was etched with the acid. Finally, in cleansing the plate, the etching was obtained from which pictures could be printed in printers' ink.

THE DAGUERREAN PROCESS.

In 1823 Louis Jacques Maude Daguerre, of Brie on the Marne, began experiments, seeking to fix the pictures in the camera, which he produced with chloride or nitrate of silver for his sensitive salt. He does not appear to have been any more successful than Wedgewood and Davy. In 1827 Niepce communicated his process of heliography or sun sketching to the Royal Society, exhibiting some of his prints from the etched plates I have just alluded to. This led to his acquaintance with Daguerre, and they continued their investigations together until the death of Niepce in 1833, and from this date the work was continued by Daguerre and Isador Niepce, the son. In January, 1839 Daguerre announced the discovery of the beautiful process which bears his name, and which took the world by surprise. When the word was first brought to this country that two French chemists had succeeded in fixing the image seen in the camera-obscura indelibly upon a silver surface, almost every one was incredulous. The moon hoax which was published in the New York *Sun* in August and September, 1835, which gave most graphic descriptions of what Lord Rosse had seen with his great telescope at the Cape of Good Hope, and from which it appeared that the moon had a vast population of human beings, whose habits, manners and mode of life were so graphically described by Locke, was still fresh in the minds of most Americans, and they looked upon the discovery of Daguerre and Niepce as simply another effort of Mr. Locke or some other equally ingenious writer.

There was one man, however, in America, who was not incredulous. John W. Draper, of New York, had been investigating the action of light, and had used pieces of paper rendered sensitive to silver salts in his investigations. He was quite prepared, therefore, to believe in the possibility of achieving all that Daguerre claimed, and immediately began experiments upon the meager information which came with the first announcement of the discovery.

Not only was he successful in accomplishing all that had been claimed that Daguerre had done, but, from his knowledge of the business and familiarity with optical apparatus, he was able to make important improvements in his little laboratory in the University.

FURTHER PROGRESS DESCRIBED.

After elaborating somewhat further the history of the various processes which have been introduced from time to time, the lecturer alluded to the painful ex-

perience of the early sitters in Dr. Draper's laboratory, where the first daguerreotypes of the human face were taken with their faces floured and blue lights streaming down upon them for fifteen or twenty minutes. He then gave a description, illustrated by specimens, of each of the new important processes. The Daguerrotypes which were so extensively taken twenty or thirty years ago, were exhibited, and the processes by which they were produced fully described. The daguerrean process, he said, had recently been revived in Brooklyn by the skillful operator Frank Pearsall, and with very great success. Some of his pictures by this process were exhibited by the lecturer.

TALBOT-TYPES EXPLAINED.

He next described what was meant by Talbot-types, invented by Henry Fox Talbot in 1839, and some of these were exhibited, the lecturer having been fortunate in securing a series both of negatives and positives from Mr. Rapp, of this city, who procured them many years ago at Frankfort-on-the-Main. These pictures were especially interesting, as they first suggest the idea of a negative for preparing a positive; and, although owing to the imperfections of the paper and the fact that much had to be learned, they were not very beautiful, still they formed one of the most interesting topics of the lecture.

Photographs without the camera were next exhibited. Ferns impressed upon sensitive paper after the methods employed by Davy and Wedgewood, but rendered permanent or fixed by the use of hyposulphate of Soda, a process which the lecturer said three distinguished chemists would have given a great deal to have known.

COLLODION PICTURES.

Collodion pictures were next noticed. Herschell had endeavored to make use of glass plates coated with silver salts for the production of negatives as early as 1840; Niepce de St. Victor first succeeded in using them, employing a film of iodide of starch, sensitized with nitrate of silver. Later, in 1847, he used iodized albumen films, but it was not until Schönbein discovered gun cotton in 1846, and its solution in alcohol and ether called collodion, was introduced by Scott Archer in 1851, that photographs now prepared with the aid of negatives became of any importance. This process has now become the key to all the various processes employed for producing silver prints, carbon prints, Albert types, heliotypes, photographs, electrotypes, lithographs and engravings.

The processes with collodion were described by the lecturer in detail. Negatives were taken before the audience, with the aid of the electric light, and were then fixed in their presence, and with them glass positives were at once printed. A beautiful series of very large silver prints was exhibited and explained, as well as a silver print of the moon photographed by Mr. Lewis Rutherford of this city, and also the moon photographed by Dr. Henry Draper, and with it the photograph of the solar spectrum, and his latest photograph, proving the presence of the free oxygen atmosphere of the sun. Large solar prints by Golder & Robinson were also exhibited, as well as micro-photographs from Philadelphia.

A series of transparencies photographed by Mr. Landy, the assistant in chemistry at the School of Mines, was shown in the magic lantern. These, the lecturer said, were extensively used at Columbia College, for illustrating the lectures.

AUTOTYPES.

Prof. Chandler next called attention to gelatine transfers called "autotypes." This wonderful process, he said, was invented by Swan, of Newcastle, England, and had been brought to a high state of perfection by Leon Lambert, of Paris. The subject was illustrated by a complete series of specimens, beginning with a silver negative and ending with a finished picture made by Lamson, of Portland, who received the prize for this class of pictures at the last public exhibition. Specimens of these pictures by Rockwood, of this city, and Adolph Braun, of Dormach, Germany, as well as a beautiful series of transparent gelatine transfers for the magic lantern by Levy, of Paris, were shown. Pictures in Prussian blue, prepared by C. L. ———, were next exhibited and explained.

THE ALBERT-TYPES.

The Albert-types, the invention of Albert of Munich, were next explained in detail, and a fine series of specimens, some prepared by Albert himself and others by Edward Bierstadt, of this city, were shown. This process, the lecturer said, begins with the silver negative, from which the gelatine relief is produced, which is placed in the printing press, and will deliver 400 impressions a day in printer's ink, which cannot be distinguished from the best photographs in silver. This process possesses one great advantage over almost every other process in which printer's ink is employed, in that it does not depend upon the picture possessing lines, but will yield from any good negative of the human face a most beautiful and highly satisfactory picture in printer's ink.

PRODUCING PICTURES IN COLORS.

Perhaps the most interesting feature of the lecture was the Professor's announcement that Albert, of Munich, had succeeded in producing pictures in colors by the aid of this process. By the kindness of Edward Bierstadt, he said, he was able to exhibit pictures in three colors produced by the aid of the photograph by Albert, of Munich. The principle was, after all, very simple. The colored picture or landscape is thrown into the camera through a colored screen. It includes all that is yellow and all that is red. There is thus produced a silver negative of everything in the picture which is blue. This is transferred to the Albert-type plate with the aid of blue ink, and all the blue parts of the picture are printed upon the paper. The experiment is then repeated, except that by the use of a different screen and an Albert-type plate all that is yellow in the original picture is secured from this with yellow ink, and the yellow parts of the picture are printed upon the same sheet of paper. The third Albert-type then prepared in the same manner for the red portion of the picture, and these in turn are printed on the same sheet of paper in red ink. Thus the Albert-type is produced by the

combination of three primary colors, which faithfully presents the contents of the original picture. The specimens exhibited by the lecturer were truly remarkable.

The Woodbury-type was next spoken of. In this process the gelatine film is produced in silver negative, which is afterwards dried and forced by hydraulic pressure to make its impression over a thick plate of lead. From this plate, in a proper press, pictures in gelatine, colored by pigment, are actually moulded either in glass or paper. Specimens of both kinds were shown, which, for their colorings and brilliancy, were remarkable.

The next process explained was the photo-gravure, which Prof. Chandler said carried the same principle one step further. The leaden plate is subjected to the galvano-plastic process, and an electrotype copying plate is produced, which is then placed in a printing press and employed in printing pictures in ordinary printing ink. A beautiful series of these pictures prepared by Goupil & Co., was astonishing for their very large size, some of them being three feet by four, and also for their beautiful brilliancy and clearness.

PHOTO ENGRAVING.

Photo-lithography, photo electrotypes, photo-zinc etchings and photo-engraving, were fully elaborated by the lecturer. In relation to the latter, he said it seemed as though the photo-lithograph and the photo-electrotype had reduced the art of reproducing the work of the artist ready for the printing press to its simplest expression, but photo-engraving carried it in point of cheapness to the verge of absurdity. He showed a steel engraving of a beautiful Magdalene, a silver negative and plaster mold, a stereotype plate and copper electrotype, all ready to adorn the page of any of the daily papers, and said that when the engraving was produced and placed side by side with the original, it was almost impossible to decide which was the $10 steel engraving and which the 10-cent or perhaps 5-cent reproduction. At the conclusion of his lecture Prof. Chandler was heartily applauded. —*New York World.*

THE PROCESSES OF MINTING.

The capacity of the various coining Mints and Assay Offices in the United States will be fully tested during the coming year. The law of February 28, 1878, demands that between 2,000,0000 and 4,000,000 of the new dollars shall be turned out every month. The officers of the Mints think that 3,000,000 will be the maximum of production for the present, and to coin as many silver dollars as that a month will require brisk work at the Mints. On the 11th of December last eleven tons of silver were sent to Philadelphia from the Assay Office in this city; seven and a half tons were sent on the 31st day of the same month, and at least twelve tons more have been sent during the last fortnight. Most of the silver received at the Philadelphia Mint passes through the New York Assay Office. There are two coining Mints besides the one in Philadelphia, one in San Francisco and the other in Carson City, and assaying and refining are done

in Helena, Montana; Boise City, Idaho; Denver, Colorado; and at a few other points in the far West. The Philadelphia Mint is capable of turning out about $1,500,000 in coined money a month; the San Francisco Mint $1,000,000, and the Carson City Mint $500,000. The Mints cannot of course, be given over exclusively to the coinage of silver dollars. The subsidiary coins must be struck, and a certain amount of gold coinage goes on all the time. Gold is needed by the Government to buy silver with, aside from all other purposes. It is coined mostly in the form of double eagles. During last month 21,210 double eagles were coined in Philadelphia, and 20 eagles, 20 half-eagles, 20 three-dollar pieces, 20 quarter-eagles and 20 one-dollar pieces were coined in the same time. The other coinage of the Philadelphia Mint during February comprised 200 trade dollars, 375,000 half-dollars, 1,461,800 quarter-dollars, 209 twenty-cent pieces, 964,-200 dimes, 600 five-cent pieces, 600 hundred three-cent pieces and 910,800 cents.

Silver is sent from the Assay Office to the Philadelphia Mint pure, or 999 fine, which is about as pure as can be. It is sent in large bars, and, when received at the mint, is melted and alloyed with copper. Coin silver is 900 fine. After being melted and alloyed, the metal is cast into ingots, which are simply bars of a convenient size for handling. The metal is then assayed to determine whether it is exactly of the standard fineness. Assaying is done by what is known as the dry or humid process. Sample for assay are taken while the silver is in a fused condition, and two assays are made of every specimen. The silver ingots then go to the coiner. They are first rolled into strips, and as the rolling process is apt to make the metal brittle, it is annealed to soften it. Silver is annealed simply by heating in an open wood fire, and then being allowed to cool gradually. The silver dollar strips are passed through the rolls nine or ten times before the first annealing and four or five times afterward. Then the process of annealing is repeated. After the last annealing the strips are run through cutters which divide them into drafts of the proper thickness for the coins; and these in their turn are run through a steam punching machine which cuts planchets the proper size for the coin. From 150 to 240 are cut in a minute. As the metal gets greasy during this process, the planchets are then dipped into a bath of diluted sulphuric acid, which is too weak to act upon the surface, but effectively removes all foreign matter. The planchets are then adjusted; that is to say, they are carefully weighed, and all that are lacking in weight are cast aside; such pieces are called "lights," and the "heavies" are the pieces which weigh too much and are filed off. The adjusting is done by women. It is a process which requires much delicacy, and scales are used which are sensitive to one sixty-fourth of a grain. After the adjusting is finished, the next operation is milling, which is done with a curious sort of machine. The edges of the coin are thrown up and grooved by this process. After another cleaning with sulphuric acid the coins are ready for the die. The stamping is done on a screw press, and both sides of the coin are stamped at the same time. The dies are cylindrical blocks of steel, upon which are carved the designs to be transferred by pressure to the coins. Art of

a high order, as well as fine mechanism, is conspicuous in this part of the coining process. The designer, in the case of the new silver dollar, Mr. Morgan, first draws his design on paper, from which is made a model in wax, of which a plaster cast is taken, and from this cast an electrotype is taken, upon which careful revision is made with the graver. This electrotype, like the model and cast which preceded it, is three or four times larger than the impression which appears on the dollar. The design is transferred to a steel die by using Hill's reducing machine, constructed on the principal of the pantograph. One arm of this instrument, with a blunt point, follows the lines on the electrotype, while the other arm, to which is attached a strong and rapidly revolving drill, reproduces the same lines on a smaller scale upon a steel block. By means of a press this impression is transferred to another block in intaglio and thence upon another block, which is the parent die. After each transfer the lines are carefully improved with a graver. Steel of the same quality as that of which the parent die is made is used for the coining dies. They are annealed, and trued on both ends. Two or three blows in the screw press, which is worked with a large wheel, secures a perfect impression, and both the obverse and the reverse of a coin are struck at once. Machinery places the planchets between the dies, and afterwards drops the completed coin in a box. Two or three pieces of each coinage are reserved for the annual Government assay.

The process of melting, refining and assaying gold and silver are carried on in the Assay Office, in this city, on quite as large a scale as at the Philadelphia Mint. Not only Government work is done here, but large deposits are made daily of gold and silver bullion by private individuals. Gold is always found alloyed with silver, and it is never found with any other alloy. To separate the silver from the gold, the bullion is boiled in sulphuric acid, which removes the the alloy; the gold is then reboiled and reduced to a coarse powder resembling clay. Its purity then is 998 or 999. The silver, mixed with copper, is run into vats on a lower floor, and is purified and granulated, when it resembles pipe-clay. The granulated gold and silver are pressed into large cheeses in a hydraulic press. A cheese of gold, twelve inches in diameter and three inches in thickness, is worth $20,000; a silver cheese of the same size is worth $900. The sulphuric acid, after it is used, produces a sediment of blue vitriol, which is much prettier than either the gold or silver seen in the Assay Office. The vitriol and the weak acid are both sold for as much money as the original acid costs. The substitution of sulphuric acid for nitric has caused a saving to the New York Assay Office alone of $100,000 a year. Depositors receive their gold and silver seperately at standard purity, 900. Pure metal is also sent to the Assay Office from the various refineries to be alloyed. From United States refineries silver is generally sent in large bars or cakes, and a small amount of Mexican metal is received in thin, irregular-shaped pieces called disks. The fumes from the vats and furnaces in the Assay Office are condensed and sold as weak acid. Only a small amount of the gas escapes into the atmosphere, and although it is slightly offensive, it is not injurious. On the contrary, this gas is an excellent disinfectant, and acts upon

dead matter rather than living. The same precautions are taken to prevent loss in the Assay Office as in the great mints. The ashes, the sweepings from the floor, the crucibles and all the instruments which come in contact with the precious metals are washed and ground in a machine constructed for the purpose, and the stray particles of silver and gold are gathered together.—*N. Y. Times.*

IMITATION MARBLE FOR MANTELS.

We are enabled to lay before our readers some additional definite details of the art of imitating fancy marbles for ornamentation.

The best material is slate, which possesses the advantage of low cost, ease of sawing and working, and fine grain. The slate comes from Vermont in the shape of slabs about an inch thick, roughed to the sizes and forms most used. The outlines are cut with a bandsaw. Marble is inferior for "marbleizing," on account of its cost and coarser grain.

The grain of slate runs in planes parallel with the flat surfaces, while marble is open and porous, and requires more coats of pigment. Rubbing and smoothing are performed in a horizontal cast-iron wheel, about 10 feet in diameter, running about 57 revolutions to the minute. For marble coarse-grit sand is used; for slate a very fine grit. After smoothing, any channels that are to be made are cut with a rotary diamond cutter, the bit being hollow and rotating about 5,000 times per minute, a stream of water passing through it preventing injury to the diamonds by heating, consequent on friction.

The channel in a "half front" is cut in about three minutes; by hand it would take one man an hour. The arm carrying the bit is heavily weighted, to ease the operator and cause greater steadiness of cut. Channels having acute angles or sunken bevels must be cut by hand, as must some irregular designs. The inner curve of the front is worked to a true line if a fire-board is to be set in, otherwise the the frame of the heater will cover any trifling irregularity, The slab being worked to the required outline and surface, is now ready for marbleizing. The ground is mineral color, ground in copal varnish, because this is a quick dryer. The ground is generally black or brown. When dry, it is ready for the veining or pattern. Upon the surface of a tank of water various colors mixed in oil are spread in peculiar characteristic patterns, these varying according as the color is ground, dropped or sprinkled on, and stirred, fanned, or otherwise mingled and intermingled. The colors do not blend. A slab being dipped edgewise in the water, is brought up so that the variegated film adheres to its surface, making the marble pattern.

The marble slabs are put in a steam kiln and kept at from 185° to 210° Fah. for 12 hours, baking the colors thoroughly. They are next coated with copal varnish, and again kiln-dried; then rubbed down with pumice-stone powder, again varnished and dried, and then rubbed with the finest polishing powder, and then with the hand, when they have a high, rich luster, and are ready to be shipped or to be put together by clamps, etc., in place.

There are about nine standard marbles which are imitated, about six or seven occasionally selected, and about six or eight odd patterns very rarely called for. Mexican onyx has, as yet, baffled the ingenuity of those who are interested in this branch of business. It is stated that the Tennessee marble is the hardest to imitate, and the Sienna the next. These are not done by dipping, as they are not veined patterns, but are produced by hand-work, somewhat as follows. To imitate Tennesse the slab is grounded in a reddish-brown color mixed in copal varnish; this color is dry in half an hour, and is then spotted with the same color, made lighter with white or darker with burnt umber, until it is covered with spots, which sink into the ground color and present a somewhat blurred appearance. When this is perfectly dry, (which will be the next day), take white paint mixed in water, and coat the slab with it, take a sponge and soak up some of the paint, and the balance will be in small white spots as in the natural marble. The blurred appearance underneath will look like various stones thrown and mixed together.

To make red Pyrenese the slab is grounded in varnish and color, as for dipping, but instead of oil colors, water colors are used. For one peculiar pattern, the slab is (after black ground) coated with brown water color, which is next partly removed by touching with a handful of thin muslin strips. These absorb the color, and leave bare places of peculiar outline. White color is then dipped on with a sponge, and runs on the cleaned places only, giving it a pattern which could not be obtained by dipping, or in any other way. The use of water colors gives a peculiar pearly or transparent effect, needed in the imitation of conglomerate stones, and by them it is hoped to imitate even the now inimitable Mexican onyx.

Where there are panels to represent various marbles on one slab, they are separated by cut lines, which are either filled with gold size, or otherwise used to act as boundaries. The veining of one stone should not appear continuous in an adjacent panel representing another kind of stone; this is a common fault, and is in part remedied by leaving a wide unveined band or channel between the panels. Where there is a small veined panel, or a series of such, on a plain black ground, the panels are first colored by dipping or hand-work, and the surrounding surface is colored with a brush.

If the general surface is veined, the panels are first made, and then covered with paper; the whole slab is then dipped, and the panels are protected by the paper. We should mention that an expert dipper can prepare the films and dip 400 square feet of slate (about 150 slabs) in five hours.—*Manufacturer and Builder.*

To Preserve Fresh Fruit.—Mr. Antonio dal Piaz recommends to place the fresh, sound fruit into a solution of sugar, made by dissolving in one litre (about 34 fl. oz.) of water 100–500 grammes (3½ to 17½ oz.) of sugar—the quantity varies with the acidity of the fruit—and 2½ to 3 grammes (40 to 50 grains) of salicylic acid. Cherries, currants, blackberries, grapes, pears, gooseberries, etc., may thus be preserved, even in loosely covered vessels, without injuring the natural aroma.

COMPARATIVE ILLUMINATING POWER OF GAS AND ELECTRIC LIGHTS.

The Electric Light company, of Paris, has erected a large frame building for the purpose of exhibiting the illuminating power of Jablochkoff's electric candle, and comparing its result with those of coal-gas. A correspondent of the *American Manufacturer*, having attended an exhibition, gives in that journal a very good account of his observations. The hall in which the experiments are made is, he says, about sixty feet long, forty wide, and twenty-five high. The walls and ceilings are white. From the latter were suspended three chandeliers, the central one having three "opalized" glass globes about one and a half foot in diameter—each surrounding an electric candle. The other two chandeliers were ordinary gas lustres, each with sixty bat-wing burners. The latter alone were lighted when the correspondent entered the hall, but they amply sufficed to illuminate it. Soon the gas was suddenly turned off, and six electric candles were lighted. Of these, three were on the central chandelier, and the others on three pillars in different parts of the room. Although all these lights were surrounded by large "opalized" globes, the difference between the two illuminations was remarkable. These six candles gave a light much more intense and "whiter" than the 120 naked gas jets. The eye experienced but little more fatigue in regarding the globes sifting the electric light, than it does in looking at the ground-glass globes of single gas-burners. On one of the walls of the illuminated hall was a series of silk specimens of all colors and tints, some of the shades being very delicate. Near by was the notice, "The electric light does not alter colors." This statement seemed to be verified by the experiments. At any rate, the smallest difference of tints were easily distinguished, after a time the gas was relighted, but, notwithstanding its great brilliancy at first, its light now seemed quite feeble, and of a dirty-yellow color, as compared with the electric illumination.

The cost of electrical illumination is estimated at from one-half to one-third the price of gas, for equal quantities of light.

ENGRAVING ON GLASS BY ELECTRICITY.

M. Planté the inventor of secondary batteries, by means of which a large quantity of electricity may be accumulated, has just discovered an excellent means of engraving on glass. Having remarked that a glass tube traversed by a platinum wire serving as electrode to a powerful voltaic current was instantaneously spread out in the form of a cone or funnel, in the midst of an alkaline solution contained in a voltameter, he made a series of experiments to determine what alkaline solution required the least electric force for devitrification. He therefore thought out the following process, which has given some remarkable results:

The surface of a plate of glass is covered with a concentrated solution of

nitrate of potash, by simply pouring the liquid over the plate laid horizontally in a shallow saucer. Then into the liquid which covers the plate of glass is introduced a horizontal platinum wire, connected at one end with the edge of the glass plate and at the other with the poles of a secondary battery of fifty or sixty elements. Now taking in the hand the other electrode, (formed of a platinum wire surrounded everywhere except at its extremity with an insulating sheath), the surface of the immersed glass is touched with it at the points where it is wished to engrave. Wherever the electrode touches, a luminous furrow is produced; and, whatever be the rapidity with which the writing or drawing is done, the traces made are found clearly engraved on the glass. If the writing or drawing be done slowly, the traces are deeply engraved; as to their width, that depends on the diameter of the wire serving as electrode; if it be sharply pointed the traces may be made of exceeding fineness. Either electrode may be engraved with, but the negative requires a weaker current.—*Manufacturer and Builder.*

STEAM HEATING OF TOWNS.

The experiment of heating Lockport, New York, by steam, by the "Holly system" initiated there at the beginning of the present winter, has proved successful. By three miles of pipe, covered with non-conducting material, and laid under ground through some of the principal streets, about fifty dwellings and other buildings, including a large public school, "have been thoroughly warmed all winter by steam thus distributed, and turned on or off as required by the tenant, with the facility of water or gas." It is stated that dwellings more than a mile distant from the steam generator have been heated as readily as those next door. Steam metres are provided, so that the consumer pays only for what he consumes, and the rates, it is asserted, do not exceed the cost of coal and wood under the old system of heating by fires. It is claimed that the system can be developed so as to furnish steam "at fifty pounds pressure, transmitted through twenty miles of pipe, thus supplying power for engines and manufactories, and steam for cooking and laundry purposes, for extinguishing conflagrations, for cleaning streets of ice or snow, or protecting hydrants from frost."

STARCH GLOSS.—This may be prepared as follows: Melt together 4 parts of pure stearin and 6 parts of paraffin, and pour the liquid into a cold form to solidify, then cut the mass into pieces weighing about one-fourth ounce. Having made a lot of starch-paste, say from one pound of starch, one of these pieces is added and left in the mass during a few minutes' boiling. When using unboiled starch-paste, a small quantity of a hot solution of starch containing the gloss is applied to a rag, and the latter gently rubbed over the fabric just before ironing.

THE ROMANCE OF ACCIDENT.

Many of our most important inventions and discoveries owe their origin to the most trivial circumstances; from the simplest causes the most important effects have ensued. The following are a few culled at random for the amusement of our readers:

The trial of two robbers before the Court of Assizes of the Basses-Pyrênées accidentally led to a most interesting archæological discovery. The accused, Rivas a shoemaker, and Bellier a weaver, by armed attacks on the highways and frequent burglaries, had spread terror around the neighborhood of Sisteron. The evidence against them was clear; but no traces could be obtained of the plunder, until one of the men gave a clew to the mystery. Rivas in his youth had been a shepherd-boy near that place, and knew the Legend of the Trou d' Argent, a cavern on one of the mountains with sides so precipitous as to be almost inaccessible, and which no one was ever known to have reached. The commissary of police of Sisteron, after extraordinary labor, succeeded in scaling the mountain, and penetrated to the mysterious grotto, where he discovered an enormous quantity of plunder of every description. The way having been once found, the vast cavern was afterward explored by *savants;* and their researches brought to light a number of Roman medals of the third century, flint hatchets, ornamented pottery, and the remains of ruminants of enormous size. These interesting discoveries, however, obtained no indulgence for the accused (inadvertent) pioneers of science, who were sentenced to twenty years' hard labor.

The discovery of gold in Nevada was made by some Mormon immigrants in 1850. Adventurers crossed the Sierras and set up their sluice boxes in the cañons; but it was gold they were after, and they never suspected the existence of silver, nor knew it when they saw it. The bluish stuff which was so abundant and which was silver ore, interfered with their operations and gave them the greatest annoyance. Two brothers named Grosch possessed more intelligence than their fellow-workers, and were the real discovers of the Comstock lode; but one of them died from a pickaxe-wound in the foot, and the other was frozen to death in the mountains. Their secret died with them. When at last, in the early part of 1859, the surface croppings of the lode were found, they were worked for the gold they contained, and the silver was thrown out as being worthless. Yet this lode since 1860 has yielded a large proportion of all the silver throughout the world. The silver mines of Potosi were discovered through the trival circumstance of an Indian accidentally pulling up a shrub, to the roots of which were attached some particles of the precious metal.

During the Thirty Years' War in Germany, the little village of Coserow in the island of Usedom, on the Prussian border of the Baltic, was sacked by the contending armies, the villagers escaping to the hills to save their lives. Among them was a simple pastor named Schwerdler, and his pretty daughter Mary. When the danger was over, the villagers found themselves without houses, food, or money. One day, we are told, Mary went up the Streckelberg to gather black-

berries; but soon afterward she ran back joyous and breathless to her father, with two shining pieces of amber each of very great size. She told her father that near the shore the wind had blown away the sand from a vein of amber; that she straightway broke off these pieces with a stick; that there was an ample store of the precious substance; and that she had covered it over to conceal her secret. Amber brought money, food, clothing and comfort; but those were superstitious times, and a legend goes that poor Mary was burned for witchcraft. At the village of Stümen, amber was first accidentally found by a rustic who was fortunate enough to turn some up with his plow.

Accidents have prevented as well as caused the working of mines. At the moment that workmen were about to commence operations on a rich gold mine in the Japanese province of Tskungo, a violent storm of thunder and lightning burst over them, and the miners were obliged to seek shelter elsewhere. These superstitious people, imagining that the tutelar god and protector of the spot, unwilling to have the bowels of the earth thus rifled, had raised the storm to make them sensible of his displeasure, desisted from all further attempts to work the mine.

A cooper in Carniola having one evening placed a new tub under a dropping spring, in order to try if it would hold water, when he came in the morning found it so heavy that he could hardly move it. At first, the superstitious notions that are apt to possess the minds of the ignorant made him suspect that his tub was bewitched; but at last perceiving a shining fluid at the bottom, he went to Laubach, and showed it to an apothecary, who immediately dismissed him with a small gratuity, and bade him bring some more of the same stuff whenever he could meet with it. This the poor cooper frequently did, being highly pleased with his good fortune; till at length the affair being made public, several persons formed themselves into a society in order to search farther into the quicksilver deposits, thus so unexpectedly discovered, and which were destined to become the richest of their kind in Europe.

Curious discoveries by ploughmen, quarrymen and others, of caves, coins, urns and other interesting things, would fill volumes. Many valuable literary relics have been preserved by curious accidents, often turning up just in time to save them from crumbling to pieces. Not only mineral but literary treasures have been brought to light when excavating mother earth. For instance, in the foundations of an old house, Luther's "Table-Talk" was discovered "lying in a deep, obscure hole, wrapped in strong linen cloth, which was waxed all over with beeswax within and without." There it had remained hidden ever since its suppression by Pope Gregory XIII The poems of Propertius, a Roman poet, long lurked unsuspected in the darkness of a wine cellar, whence they were at length unearthed by accident, just in time to preserve them from destruction by rats and mildew. Not only from beneath our feet but from above our heads may chance reveal the hiding places of treasure-trove. The sudden falling in of a ceiling, for example, of some chambers in Lincoln's Inn, revealed the secret depository of the Thurloe state papers.

MEDICINE AND HYGIENE.

HOME-MADE MINERAL WATERS.

A writer in the *Medical Press and Circular* says: At my instigation, some of my medical friends have used the following mixture where the bitter saline purgative waters of Friedrichshall and Hunyadi Janos were indicated, with equal if not more satisfactory results in abdominal diseases, hepatic congestion, even attended with hemorrhoids, plethora, etc.:

Sulphate of soda	3 drachms.
" " potassa	3 drachms.
" " magnesia	4 drachms.
Bicarbonate of soda	1 drachm.
" " potassa	1 scruple.
Water	20 ounces.
Muriatic acid	1 drachm.

Mix. The bottle is to be kept well corked, and in a cool place.

A wine-glassful the first thing every morning, in a tumbler of cold water. The addition of the muriatic acid answers a twofold purpose: it saturates the mixture with carbonic acid gas, making it more palatable, and the small quantities of chlorides it generates adds to its efficacy in a surprising way. Sulphate of potassa is the best cholagogue in the saline shape, and invariably enters largely into all the natural waters of use in hepatic congestion. But all the natural waters contain more or less sulphate of lime (in common *parlance*, plaster of Paris), which adds nothing to its efficacy, and is objectionable.

Again: in gouty and rheumatic diatheses, where an iodized alkaline aperient is indicated, the following may be prescribed, and will be found far more efficacious than any of the natural waters:

Dry sulphate of soda	3 ounces.
" " " potassa	6 drachms.
Bicarbonate of potassa	2½ drachms.
Carbonate of lithia	½ drachm.
Iodide of potassium	½ drachm.

Mix. Dose, a teaspoonful the first thing in the morning in half a pint of tepid water.

If the patient prefer cold to tepid water, plain cold, or aerated may be used.

In renal affections, where a course of the warm alkaline waters of Vichy or Carlsbad, or the cold ones of Val, Jachingen, and Marienbad are desired, we may use (as Dr. Wade suggests) dilute solutions of potassa and soda bicarbonate with citrate of lithia. Sir H. Page has found soft or distilled water of great service in the palliative treatment of renal affections, and either the one or the other should

always be used in the preparation of the solutions. They may be taken warm, or charged with carbonic acid.

By adopting such measures as these, we can confer, in some measure, the boon of mineral waters on the poor patients, which is now only enjoyed by the wealthy.—*Druggists' Circular.*

VICHY WATER, ARTIFICIAL.—Dorvault gives the following formula:

Sodium carbonate	1364	grains.
Sodium chloride	31	"
Calcium chloride, cryst	77	"
Sodium sulphate	77	"
Magnesium sulphate	21	"
Ferrous sulphate, cryst	1	"
Water	210	fl. oz.

Impregnate with 4 volumes of carbonic acid gas, at 5 atmospheres.

CONGRESS WATER, ARTIFICIAL.—The following formula represents the natural water, according to the best published analyses:

Sodium chloride	1966	grains.
Potassium chloride	163	"
Calcium carbonate, freshly prec	585	"
Magnesium carbonate, freshly prec	411	"
Sodium carbonate	83	"
Sodium bromide	16	"
Strontium carbonate, freshly prec	7	"
Ammonium chloride	3	"
Manganese carbonate	2	"
Sodium iodide	½	"
Iron, sulphate (ferrous)	2	"
Water, charged with carbonic acid gas	8¾	galls.

—*New Remedies.*

RUSSIAN REMEDY FOR HYDROPHOBIA.—A correspondent of *Land and Water* (London) describes the following Russian treatment of Hydrophobia: In Saraton the inhabitants collect the larva of the rose beetle (*Cetonia aurata*), which are chiefly found in the wood-ants' nest. The grubs are gathered in the spring, placed in earth, and their change of metamorphosis watched for. When this takes place they kill the beetles and dry them. The powdered insect must be kept in hermetically sealed bottles, or the dried beetles may be kept in sealed pots and reduced to powder when wanted. Three beetles powdered are considered a dose for an adult, given immediately after the bite. One for a child and five for an adult in which the disease has declared itself. The effect is to produce a long sleep, which must not be interrupted. The bite is also treated surgically. The beetles caught on flowers are not so beneficial; they must be secured in the larva stage, and killed directly after they attain the imago. Some of the Russians give their dogs occasionally half a beetle as a preventive.

BOOK REVIEWS.

TERTIARY FLORA OF THE WEST, by Prof. L. Lesquereux; Hayden's U. S. Geological Survey, Volume VII, Government Printing Office, Washington, 1877.

We have received from Professor F. V. Hayden, the distinguished scientist, who for years has been in charge of the Geological Survey of the Western Territories, Volume 7, Tertiary Flora of the West, by Professor L. Lesquereux, of Columbus, Ohio, the venerable and eminent palæophytologist, whose specialty in Fossil Palæontology places him first in that department in the New World, and whose labors in the Carboniferous Flora of Pennsylvania, Ohio and Kentucky, and in the Tertiary of Alabama are so well known, and lastly, whose elaboration of the Lignitic Flora, now so splendidly completed, makes a most-fitting sequel to his unique Flora of the Dakota group.

This volume, of rare importance to Geology, is evidence of the sagacity and the true disinterestedness in the cause of science, shown by the selection of such a fellow-laborer by Prof. Hayden, whose staff of assistants combine together the very best intellect of the nation, whose zeal for science has a noble monument in the successive volumes of Hayden, Cope, Lesquereux, Meek, Holmes, Gardner, Maviue, Sullivan, Peale and other valuable assistants.

We will not here attempt to give more than an outline of the history of the Tertiary Flora of the West; which, since 1860, has occupied so much argument and study from its intimate connection with the age of the vast Lignitic Coal formation of the Rocky Mountains; extending from the estuary of the McKenzie river to Southern New Mexico, presenting an area of coal formations exceeding in amount all the coal fields of the so-called true carboniferous formation known in Europe, Asia and America.

To Lewis and Clark we are indebted for the first knowledge of the Lignite Coal, noticed by them in their exploration of the head of the Missouri river.

Later explorations revealed their presence in the Raton Mountains of New Mexico, while Milton and Cheadle and Dr. Hector have shown their large extent in British America, especially on the River Saskatchawan, where in latitude 51° 52′ north, the river banks show large deposits of excellent Lignite Coal; while the McKenzie lignites show in their fragmentary Flora a close alliance to the tertiary types of plants of the Lignite beds.

Even in Alaska Prof. Heer shows a small development of Lignite, probably miocene, and among whose plants we find some even identical to the Lignite Flora of Golden.

Prof. Lesquereux gives us, in the Tertiary Flora, his views of the value of the testimony of the few isolated cretaceous fossils, both vertebrate and invertebrate, that have been so much insisted upon as proving the cretaceous horizon of the Lignitic beds of the Rocky Mountains.

Prof. Lesquereux carefully and patiently, and with rigorous justice, analyzes the comparative values of the evidence of the different species, genera and natural families, bearing upon the stratigraphical evidence of geological succession.

We may even say the geological habitat of each genera, and even of species, is rigorously compared with European authorities and European localities. His table of groups is also well imagined, showing clearly for every species their locality, and their appearance in well authenticated localities abroad, as well as in the West.

As might be expected, Prof. Lesquereux, after this final and more mature effort in elucidation of the problem of the age of the Lignitic formation, maintains his original ground of its tertiary origin, and as to the value of the testimony of a few vertebrate and invertebrate fossils, cited in evidence, against the clearly proven and well substantiated evidence of an overwhelming Tertiary Flora; whose types, genera and even species are identified in Alaska, Greenland, Switzerland, Bohemia, Italy, France, etc., all prove well established, undisputed Tertiary formation.

The theory of the learned Professor that inasmuch as "no remains of deep marine cretaceous types have been discovered in the whole Lignitic measures above Point of Rocks" locality, he is willing to admit, however, that as the Tertiary age in "principio" was necessarily a land formation, a cretaceous marine fauna may have still persisted in deep seas; that the presence of the Saurian Agathaumas at Black Buttes is the wandering of an animal out of its domain; the land surface at the Lignitic period was like the gulf shore at present time—a belt of sand downs served as a barrier to the sea; back of it there were marshy swamps, peat bogs, impenetrable by reason of luxuriant vegetation, whose animal life is limited to saurians. "A formation of the same kind is remarked all along the western coast of Africa."

The writer of this summary of the Tertiary Flora has seen very much the same on the coast of South America. A ridge of sand and comminuted corals and shells, forming a low breakwater, occasionally cut through at spring tides, the ridges covered with a dense growth of palms, brambles, manchineel and hibiscus, behind the ridge brackish water lagoons, into which, in the rainy season, emptied countless rivulets of fresh water, the drainage of vast and almost impenetrable swamps, the abode of a great variety of saurians, chelonians, and ophidians, with an occasional mammal, such as a manatee, or tapir, all other mammals, even monkeys, shunning their miasmatic solitudes. Here in the lagoons, whose underlying rock was Post Pliocene or Pliocene, could be found an extraordinary assemblage—fossil shells of the fresh water swamps mingled with the aviculas, solens, donax, arcas, pectens, turbas, ostreas, pholadas, cypreas, volutas and chambered spirulas of the adjoining sea. Hurled in among them or swept down by floods were green turtle and alligator bones, fresh water turtles, large boas, with an occasional tapir carcass, all mingled together in the deep black mud formed by the decay of an exuberant plant and tree growth, gathered in fathomless

swamps. Such, we may well conceive, were the conditions attending the slowly upheaved wastes of the Tertiary age.

Touching the question of superposition of formation, and the principles of the classification adopted in the case of the Tertiary formations, Messrs. Geikie and Jukes thus announce in their Manual of Geology, pages 670 to 672, Edinburgh edition 1872—*loc. cit.* Speaking of the Primary and Secondary epochs: "We can, therefore often determine their order of superposition by their geognostic relations only. * * * When, however, we come to examine the Tertiary rocks of the same area, we find that, either from having been deposited in separate seas, or from subsequent denudation, or from both causes combined, they now form detached patches, so their order of superposition can rarely be determined by simple inspection." Again, page 672: "*The Eocene beds of England* rest upon the upper surface of the *chalk* in *apparent* conformability; that is, there is no apparent *difference* in *the dip* or *strike* of the two groups. That there is, however, an unconformability between them, seems probable." An unconformability which can be seen at Golden and other points at the east base of the Rocky Mountains. E. W. B.

Golden City, Colorado, March 20, 1878.

Method of Arithmetical Instruction, by F. W. Bardwell, Professor of Astronomy in the University of Kansas. G. P. Putnam's Sons, New York, 1878. pp. 36, 12mo. For sale by Matt. Foster & Co. 15c.

This is an essay by a skilled mathematician and experienced teacher, written in the interest of accuracy and perspicuity in text books of arithmetic, and introductory or rather preliminary to a work on Arithmetic now in preparation by the same author. Despite a somewhat hypercritical manner, it is full of ideas and points worthy of consideration by teachers who either follow the old time, rigid, non suggestive rules and methods, or who have attempted to keep abreast the somewhat effusive modern styles of teaching; and, judging from the clear and logical tone of the writer in this little monogram, the comprehensive treatise which is announced will be a valuable work for both students and professors.

The Silver Country, or the Great Southwest, by Alex. D. Anderson. G. P. Putnam's Sons, New York, 1877. pp. 221, 12mo. For sale by H. T. Wright & Co. $2.00.

Anything on the subject of silver is read with avidity at the present time, and this contribution to the literature of the much discussed metal, being replete with authentic statistics and written in an attractive style, will doubtless meet with a large demand. It is a review of the mineral and other wealth of the former kingdom of New Spain, comprising Mexico and the Mexican cessions to the United States, now subdivided into Texas, California, New Mexico, Nevada, Arizona and Utah, and aggregating 1,729,091 square miles.

After a general description of this immense territory, the author devotes nearly fifty pages to tabular statements of the silver and gold production of the

different sections, with comparative statistics instituted with reference to those of other auriferous and argentiferous regions of the world as well as to those of the world itself, making a most satisfactory case on all points.

Then follow two most fascinating chapters on "Other wealth than silver and gold," and "Luxuries and attractions," which portray in brilliant colors the remarkable products of the soil, the scenery and climate, fruits and wines, antiquities, &c. To those of our readers who have visited Nevada, Old and New Mexico, and many other portions of New Spain, this vivid description of its luxurious and spontaneous vegetation will seem largely overdrawn and may have the effect to cause them to discredit other statements in the work, but since full references to standard authorities are given in all instances where statistics of mineral wealth are furnished, these apparent exaggerations must be attributed to an enthusiastic partiality on the part of the author for the region he describes.

His comparisons show that this region from 1521 to 1804 yielded forty-three per cent. of the silver product of the whole world; from 1804 to 1848 fifty-six per cent.; from 1848 to 1868 fifty per cent.; from 1868 to 1875 sixty-five per cent.; and during 1875 seventy-five per cent. of the silver product of the world.

The conclusion is that if such has been the history of the Great Southwest in its comparatively undeveloped condition, the advance of railways into Arizona, New Mexico and the northern States of Old Mexico will give rise to a silver production still more wonderful.

The object of the book possibly reveals itself in the author's remarks upon the importance of railways and telegraphs in opening and settling up this region, by the aid of which "this rich land is destined to show a record of material development and wealth unparalleled by any history yet written."

Whether this is the real object of the book or not, its publication will have a tendency to give new zeal to the originators and managers of the Southern railway route to the Pacific and to enlist in the project many persons who have hitherto known very little about the country through which it passes.

The book is illustrated with a hypsometric map of the region under discussion, and is handsomely printed and bound.

THE BOY ENGINEERS: WHAT THEY DID, AND HOW THEY DID IT. A book for boys. By the Rev. J. Lukin. 334 pp. oct. 30 plates. G. P. Putnam's Sons, New York, 1878. For sale by Matt. Foster & Co. $1.75.

This is the third or fourth work of the same character by the same author, and being written in like fascinating style, it will doubtless meet with the same success as its predecessors.

It purports to be a record of the experiences of a couple of boy brothers, who, having a mechanical turn of mind, devoted themselves to the use of various tools in the construction of articles for use and amusement. These experiences, while related by the boys themselves in a clear and attractive manner, contain practical information upon numerous subjects of interest connected with the work in hand, and form a valuable guide for other boys who are similarly inclined.

Such books as these cannot fail to be of the greatest benefit to the boys of the present generation, and they should be found in every school library, as well as in the homes of all parents who wish to keep their boys out of the streets by the easy and practical method of entertaining them more agreeably at home.

Putnam's Sons have spared no pains to bring the book out in suitable and elegant style.

Memoir of the Centennial Celebration of Burgoyne's Surrender. Schuylerville, N Y., October 17, 1877. pp. 190, octavo. Joel Munsell, Albany, N. Y., 1878.

On the 19th of April, 1860, the Saratoga Monument Association was incorporated, its object being the collection of memorial data concerning the surrender of Burgoyne, and the erection of a monument to perpetuate the history of the occasion.

Seventeen years afterwards and just one hundred years from the day of the surrender, which was without doubt the turning point of the Revolution, the people of the vicinity and many from different portions of New York and the country at large, met at Schuylerville and laid with imposing forms and ceremonies the corner stone of a magnificent granite monument, almost upon the exact spot where on the 17th of October, 1777, General Burgoyne delivered up his sword and army to General Gates, commanding the American forces.

The occasion was befittingly celebrated and addresses were made by some of the most eminent orators in the country, among them Ex-Gov. Horatio Seymour, George William Curtis, Hon. L. S. Foster, Alfred B. Street, W. L. Stone, and others, all of which, together with many most interesting items of history, have been carefully brought together by William L. Stone, Secretary of the Monument Association, and handsomely preserved in the volume whose title is given above, by the publisher, Joel Munsell, who is also a well known antiquarian and writer of Albany, New York.

Between the Gates, by Benj. F. Taylor. With illustrations. Chicago, S. C. Griggs & Co., 1878. 12mo. pp. 292.

The fascinating, though rather "red hot" style of Mr. Taylor, so well known to the many readers of his "World on Wheels," "Camp and Field," &c., is well kept up in this his latest work, and the many objects of interest seen between Chicago and San Francisco and upon the coast of California, during a summer's pleasuring, are described in an off-hand and at the same time a picturesque manner. Despite a proneness to the somewhat wearisome use of over familiar quotations and a weakness for rather feeble puns, Mr. Taylor's style is exceedingly attractive, and nothing worth seeing escapes his eyes. His descriptions of "the Californian twenty-two carats fine," and "the genuine old forty-niner, covered with Spanish moss and mistletoe," scorning the greenbacks, the nickels and the copper goddesses of Liberty of the "States" are in his finest vein, while that of "going to China," as he felicitously calls a visit to the Chinese quarter, is more

strikingly, alarmingly suggestive of the Asiatic barbarism existing and tenaciously thriving in our land than all the comprehensive and long-winded reports which have yet been made to or by Congressional committees.

Every chapter teems with facts expressed in the most glowing language and and presented in a form which gives them the freshness of recent discoveries, from the visit to the Geysers to that to Los Angelos and the Mission of San Gabriel, and the book will be read with pleasure and profit by all. Like all of S. C. Griggs & Co.'s publications, this book is a model of good work in printing, paper and binding.

CHRONOLOGY OF THE ORIGIN AND PROGRESS OF PAPER AND PAPER MAKING, by Joel Munsell. Albany, N. Y. pp. 264. 12mo. $1.50.

This interesting work has passed through five editions and probably presents the most perfect history of the subject so far as chronology is concerned, that has been published.

Pliny states that Numa, who lived three hundred years before Alexander, (670 B. C.) left several works written upon papyrus, which is the earliest mention of its use among the Romans, though it is more than likely that the Egyptians used it centuries earlier.

In A. D., 95, Du Holde says that a mandarin of the palace manufactured paper of bark of trees and old silken and hempen rags. Casiri, a Spanish author, attributes the invention of cotton paper to Amru in A. D. 706 at Mecca, but it is attempted to be shown by Montfaucon that it was discovered in the empire of the East about the beginning of the 10th century, while other authorities equally good claim that the Chinese and Persians were acquainted with its manufacture much earlier than either of these dates.

The oldest manuscript in England written on cotton paper is in the Bodleian Collection of the British Museum, having the date A. D., 1049, while the oldest in France is to be found in the Royal Library at Paris dated A. D. 1050.

The first paper mill in America was established in 1690 near Philadelphia, by William Rittinghausen, now spelled Rittenhouse.

No end of substitutes for cotton rags have been proposed and tried, and in 1772 a book was printed in Germany containing upwards of sixty specimens of paper made of different materials—the result of one man's experiments.

A reading of this book reveals the fact that almost numberless patents have been issued to inventors for articles made of paper during the past century, from petticoats to car wheels.

The work is the result of diligent research, and is equally interesting to the general reader and valuable to the paper maker and stationer.

LENA, THE SILENT WOMAN, by the author of "King's Cope." Loring, Publisher, Boston, 1878. pp. 344. 12mo. 50c. Sold by H. H. Sheppard.

This is one of Loring's tales of the day, for town and country readers and is a very entertaining, readable tale of English life, though it would be difficult to explain why the author should have made Lena, who is his most attractive and

best character, both in person and in mind, the "silent woman" and should have finally closed the story leaving her an old maid, or at least unmarried. "Strange are the uses, &c."

THE UNIVERSE OF LANGUAGE: Uniform notation and classification of Vowels adapted to all Languages, by the late Geo. Watson, Esq., of Boston. Edited by his daughter. 12mo. pp. 344. New York: The Author's Publishing Co., 1878. Price $1.50.

While in part a labor of love on the part of a dutiful daughter in perpetuating the literary efforts of a revered father, this work is likewise a monument to the learning, industry and discriminative ability of both. Mr. Watson was a writer whose ideas were regarded as broad and comprehensive and at the same time expressed in scholarly language and attractive style. In this, his posthumous volume, none of these characteristics are wanting, while in respect of deep, careful, and impartial consideration of the subject, it is the best of all.

Miss Watson has evidently devoted much time and research to the same subject, and her contributions to the work are characterized by a skillful handling worthy of better known philologists.

The first part, upon the Nature of Language is by the daughter; the second, upon the Structure of Language, and the third, upon the Reading and Spelling Reform, are by the father.

The design of the author is to classify the natural sounds of the human voice as contained the various spoken languages, and to apply through this classification, a simple uniform system of pronunciation for all languages—Oriental as well as European; pointing out the elements in which all of them agree and thus approaching a Universal language. In attempting this the author has searched through those tongues descended from the Aryan, the Semitic and the Turanian for words, syllables and vocal sounds which are similar, and has arranged them in tables for comparison. Upon this basis he builds a plausible structure most interesting to the general reader and instructive and suggestive to the student of ancient and modern literature.

The work is published in good style and is offered at a lower price than usual for books of its size and class.

SMITHSONIAN REPORT, 1876. With appendix. Octavo, pp. 488. Washington: Government Printing Office, 1877.

This is the thirtieth report of the Regents of the Smithsonian institution, and comprises the report of the Secretary, the report of the Executive Committee, the proceedings of the Board of Regents for the annual session of 1877, and a general appendix consisting of valuable contributions to science from various sources, domestic and foreign.

The work done by this institution is probably less appreciated by the general mass of the people than that of any other association of distinguished scientists in the world. Aside from building up an immense and most interesting museum,

art gallery and library, which are necessarily local in their benefits and influence, the Regents, under the management of Professors Henry and Baird, have persistently adhered to their original conception of the wishes and design of Smithson and devoted themselves to increasing and diffusing knowledge by means of researches, publications and exchanges, While a library of over 70,000 volumes has been gathered together, a museum probably unsurpassed in the world accumulated, and an art gallery, unusually attractive in many respects, founded, the main object, as they understand it, has not been overlooked. Many valuable works have been published, all branches of science have been advanced, and the Institution is most highly regarded by Scientists all over the world.

A Hand book of Volumetric Analysis, by Edward Hart, S. B , Fellow of Chemistry in the John Hopkins University. New York: John Wiley & Sons, 1878. 12mo. pp. 326. Price $2.50.

Though designed by the author for use by college classes and in technical schools, this work will be found of extreme convenience to professors and practical chemists in their daily laboratory work and experiments.

Volumetric analysis, invented by Descroizilles and improved by Gay-Lussac, is principally adopted by those chemists who are engaged in technical work where frequently it is only necessary to ascertain the quantity of some one substance present in a known weight of a given specimen and where a speedy result is of importance.

Professor Hart has condensed the whole subject into a small compass but has apparently omitted no process which has stood the test of experience. His explanations are clear and simple and at the same time precise and exact.

Part I contains directions for the selection of apparatus, correction of errors, preparation of solutions, &c. Part II is devoted to the methods of estimating the elements and their more important compounds. Part III contains a few cases of the application of methods described in Part II.

Some of the more interesting chapters to the amateur chemist are those upon "Analysis of Silver Alloys, Coin, &c.," and upon "Water Analysis."

The index is very full and the whole work is arranged conveniently and logically for a hand-book or ready reference book. The mechanical work of the publishers is tasteful and substantial in all respects.

EDITORIAL NOTES.

In commencing the second volume of the Review, we take occasion to thank the citizens of Kansas City, especially, for the support given it during the past year. They have, as in all matters of public enterprise, (for we presume no one has any idea that the Review is expected or intended to be a profitable individual undertaking), come to its assistance as a matter of course, knowing that such publications, in their peculiar way, reflect credit upon the intelligence of the people among whom they are published, and add to the attractions of the place itself to intellectual and refined persons who are looking for homes in the West.

Aside from this consideration many have subscribed for it as the organ of the Kansas City Academy of Science, hoping to be of service to the cause of science by aiding in the publication of its proceedings and the papers read by its members.

Numbers doubtless have subscribed for it out of personal friendship for the editor. To all of these classes we are exceedingly grateful; at the same time we are not too modest to say that we think we are giving them their money's worth in full. Nor are we too proud to say that we need at least one hundred more subscribers in this city in order to make the Review pay expenses, and we ought to have them. The subscription price is lower than that of any scientific periodical of the same size in the country, and every number contains something interesting and valuable to every person or family of intelligence in the city. Our list of contributors and exchanges is unsurpassed in the West, and both are increasing with each number, thus making it an easier task for the editor to furnish the variety necessary to suit and gratify readers of such diverse tastes and occupations. Take the present number as an example. In it we present our readers original articles by able writers from Missouri, Kansas and Colorado, and selections from some of the very best and most valuable periodicals in this country and Great Britain.

Without egotism we may point to the numerous complimentary comments by the scientific press of the country in corroboration of what we have said above, and close these remarks by urging our fellow citizens who have not already subscribed, to do so at once and thus enable us to carry forward this enterprise unhampered by the knowledge that we shall have to make up at the end of the year a pecuniary loss.

Numbers of our subscribers have availed themselves of the low price fixed in our last number for binding the Review ($1.00 per volume), and express themselves well pleased with the work done. The offer is still open —or we can furnish a few volumes handsomely bound in half-morocco at $3.00 each.

The Kansas City Academy of Science has held two monthly meetings since our last issue, both of which were well attended, and proved very interesting to those present.

At the first, held on the evening of February 26, Judge E. P. West presided, and Professor Crosby read an article upon "Vesuvius," illustrated by plaster models, specimens from the volcano and photographs of various scenes in the buried cities. This interesting paper will be published in full in a subsequent number of the Review.

Before the close of the meeting Professor Phillips, of the Benton School, was elected Recording Secretary.

The March meeting was held on the evening of March 26, 1878, and was also fully attended. Pres't R. T. Van Horn occupied the chair.

The first paper read was by Miss Mary E. Murdfeldt, of Kirkwood, Mo., upon the subject of "Forest Tree Borers." Miss Murdfeldt is a confirmed invalid, and devotes much of her time to Entomology. The paper attracted much attention, and was listened to with decided interest.

The second paper was by Capt. Trowbridge, upon "National Defense and Military

Education." This was so highly regarded that it was voted that a copy should be sent to the chairman of the House committee on Military Affairs, at Washington.

It must not be forgotten by our citizens that the next semi-annual meeting of the Kansas State Academy of Sciences will be held in this city in the month of June, and that the necessary steps for properly caring for the distinguished gentlemen who will be present at that time, must soon be taken by those interested.

Do not forget that we can club the Review with any one of the scientific and literary magazines of the country, so as to save to subscribers one dollar or more on the two.

Mr. Guffin permits us to publish the following extract from a private letter of Rev. Henry W. Bellows, commendatory of Col. Van Horn's recent address before the Kansas City Academy of Science:

New York, April 1, 1878.

Dear Sir: I have read with great interest the article of Hon. R. T. Van Horn on the Atmosphere, etc. If he is not a professional scientist it is all the more remarkable, and if he is, it is worthy of any one of them! It is so rare for scientists to put their knowledge into pleasant, readable English! If you meet him, give him my thanks and best respects.

I read a good deal of modern science, but rarely anything as fresh and satisfactory as this. I shall advise Prof. Youmans to copy it into the *Popular Monthly*, if he has not already cribbed it. * * *

Yours cordially,
H. W. Bellows.

When it is remembered that Dr. Bellows is a man who weighs his words, is one of the ripest scholars in the country, and if not reckoned among, is intimately associated with the eminent scientists both of this country and Europe, the compliment which he pays Col. Van Horn will be fully appreciated by his fellow citizens.

Besides this the following highly appreciative notice of Col. Van Horn's paper, appears in a communication to the Kansas City *Times* of March 29:

"The late paper of Col. R. T. Van Horn on the philosophy and phenomena of winds, read before the Academy of Sciences, and published in the *Western Review of Science and Industry*, makes a complete and most noticeable innovation upon the doctrines long since thought to be established. The author, though confronted by the dogmas of scientific men of all other times, goes right on, with a singular boldness of thought, in the very face of authority, and by a liberal and logical induction of facts does actually account for the phenomena of winds, storms, etc., upon a principle altogether new, while at the same time he most clearly demonstrates that atmospheric currents are not and cannot be referable to the heat of the solar rays, a doctrine held by meteorologists for more than two hundred years. I sincerely hope that the attention of thoughtful men throughout the country may be called to the consideration of the aforesaid paper, and it is to this end that this little note here appears."

We have also received very complimentary comments upon the same paper from Prof. Kedzie, of Manhattan, Kansas, Capt. Henry King, of Topeka, and many of the most intelligent of our own citizens. The paper has also elicited favorable notices from several more of our exchanges.

To any new subscriber to the Review for this year, who desires it, we will furnish a bound copy of the first volume for $3.00.

Rev. Henry Ward Beecher, in his lecture here last month, while insisting upon the importance and necessity of absolute truth-telling at all times, declared that there were "more lies told in New York City in one day than the number of mosquitos bred in the Dismal Swamp in a year." To reduce this to actual figures: Every female mosquito lays from 250 to 350 eggs, (say 300), six times during an ordinary season. Of these probably three-fourths are destroyed either in

the egg or the larval state. Now, it is fair to suppose that in so large a body of land and water as the Dismal Swamp there are at least 10,000,000 of mosquitos to start with, one-half of which are females. On this basis we have 2,250,000,000 mosquitos produced in a single season, and, accordingly, 2,500 lies per day for every inhabitant of New York City! Sad if true!

THE meteorological records published on pages 25 and 27 of this number, show March, 1878, to have been of remarkably moderate temperature, but the following items from our own private record for the years 1867 to 1878 inclusive, (except 1874), will probably give to the ordinary reader a more appreciable idea of the *contrast between its temperature than that of any of them.* The same peach trees, for instance, bloomed in each of the above named years respectively, as follows: April 24th, 3d, 19th, 12th, 3d, 25th; May 3d; April 29th, 10th, 20th; *March 21st.* We cut asparagus from the same bed, as follows: 1869, April 18th; 1870, April 24th; 1871, April 9th; 1872, April 25th; 1875, April 29th; 1876, April 16th; 1877, April 21st; 1878, April 4th.

The latest snów or ice in each of the same years, was as follows: 1867, May 2d, snowed one inch; 1868, April 5th, ice half inch thick; 1869, April 12th, snowed at noon; 1870, April 16th, snowed several times, ice three-fourths inch thick; 1871, April 20th, snowed several times; 1872, May 1st, raw and cold with a little snow; 1873, April 15th, snowed all day; 1875, April 11th, snowed several times, April 17th, ice half inch thick; 1876, March 27th, 6 inches snow, disappearing April 4th; 1877, April 3d, snowed a little; 1878, *February* 24th, snowed nearly all day.

PUBLICATIONS RECEIVED.

With the beginning of the new volume we add to our exchange list the following well-known English periodicals, from which we shall, in the future, as in this number, make copious selections:

The Chemical News and Journal of Physical Science, Vol. xxxvii, London, England, weekly, edited by Wm. Crookes, F. R. S. Price 4d. This journal has been established twenty-six years, and is regarded by all chemists as one of the standard chroniclers of current discovery in Chemistry and Physical Science. Nor the least of its attractions consists of a weekly list of chemical periodicals published with abstracts of all their valuable articles susceptible of abridgment.

The Scientific and Literary Review, Vol. xiii, monthly, 16 pp. quarto. Price 6d., published by the Inventors' Association, 21 Cockspur St., London, England. This is a Record of Progress in Arts, Industry and Manufactures, and is carefully and ably edited. One of its most interesting features is its full and complete reports of the proceedings of the numerous learned societies in London and vicinity, which are extremely interesting.

IRON.—*The Journal of Science Metals and Manufactures*, established 1823, Vol. xi, new series, 20 pages folio, weekly. Price 6d. This is a newspaper somewhat similar in appearance and purpose to the *Scientific American*, and is copiously illustrated. Particular attention is paid, as its title indicates, to iron and steel productions, but its general scope takes in all matters connected with manufactures in all lines and materials.

The Qaarterly Journal of Science, No. LVII, January, 1878, Ludgate Hill, London, England, edited by Wm. Crookes, F. R. S., etc., pp. 144, octavo. Price 5 shillings. It is altogether unnecessary to say anything concerning the character and objects of this well-known periodical, as its reputation is world-wide. The contents of the present number, besides its copious notices of Scientific Works, are as follows: 1. Continuous Railway Brakes, by Fred. Chas. Danvers. 2. On Residual Phenomena. 3. The Action of Light upon the Colouration of the Organic World. 4. On the Discovery of Stone Implements in Glacial Drift in North America. 5. New Theory of Trance.

We have also received as exchanges, *The American Manufacturer and Builder*, Vol. x, published by H. N. Black, and edited by P.

H. Vander Weyde, M. D., New York. The *Manufacturer and Builder* is a large monthly folio of 24 pages, ably edited, handsomely printed, and profusely illustrated. It is devoted, as its title indicates, to the interests of Architects, Artisans, Manufacturers and Builders, and should have as large circulation among such classes in the West as it has in the East.

Potter's American Monthly Magazine, published by J. E. Potter & Co., Philadelphia. Price $3. This is one of the handsomest, cheapest and most popular literary monthlies in the country. It is in its tenth volume, and its reputation is becoming better with each year. The April number has articles by popular and accomplished writers on Ceramic Art, Archæology, The Thousand Islands of the St. Lawrence, etc., all graphically and fully illustrated.

T. B. PETERSON & Brothers, Philadelphia, Pa., are now publishing a new edition of Charles Dickens' novels, which for beauty and cheapness far surpasses any ever before issued. It is called "Peterson's American Edition," printed on fine white paper, from large clear type, leaded, with some of the original illustrations as selected by Mr. Dickens and designed by Phiz, Cruikshank, Browne, Maclise and other artists, and bound very gorgeously in red vellum, gold and black, with the cover filled with the author's principal characters, which he has made so world-famous. There in one corner is the immortal Pickwick, in another the well known Micawber, the learned Capt. Cuttle, poor little Oliver Twist, the misguided Grandfather, the mean, hypocritical Pecksniff, the mercenary Squeers, Boots, The Beadle, etc., and all of this for the small sum of $1.25. This edition will be found for sale at all Book Stores, News Stands, and on all Rail Road Trains, or any person sending the Publishers $12.00 will receive the first twelve volumes as fast as published by mail, postage paid, and at this low price every one that is fond of a handsome book ought to subscribe. Address all orders to T. B. Peterson & Brothers, No. 306 Chestnut Street, Philadelphia, Pa.

The current numbers of Popular Science Monthly and Supplement, Van Nostrand's Engineering Magazine, Scientific American, Boston Journal of Chemistry, Silliman's Journal, Journal of the Franklin Institute, London Journal of the Telegraph, London Journal of Applied Science, Monthly Weather Review, American Naturalist, The Sanitarian, and Phrenologist are at hand, and contain articles of the highest value in their respective departments of science.

Also, North American Review, The Atlantic Monthly, The International, Harper's Monthly, and Appleton's Journal, five of the very best literary journals in the United States, to which we have frequently referred in these columns and shall frequently do so hereafter. Also the Library Table, The Literary World, The Bookseller, &c.

Also, the Gardener's Monthly, Kansas Farmer, Western Agriculturist, all first-class agricultural papers.

We have also been favored with the Leavenworth Daily Times, Brookfield Gazette, Ouray Times, Miami Republican, Industrialist, Kansas Collegiate, Dade County Advocate, Utica Herald, all of which have kindly noticed the REVIEW from time to time, and are justly entitled to our thanks.

Our own Kansas City papers, The Journal of Commerce, Times, Evening Mail, Price Current, and Post and Tribune have at all times encouraged the REVIEW, and have generously aided it with good words, for which we are under continual obligations.

All subscribers who have not paid their subscriptions for last year will oblige us by doing so as soon as possible.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. MAY, 1878. NO. 2.

ORIGINAL ARTICLES.

THE GREAT PYRAMID AND ITS SYMBOLISMS.

BY REV. JAMES FRENCH, DENVER, COLORADO.

The Pyramids, on account of their huge proportions and great age, have long been classed among the seven wonders of the world.

To obtain some idea of the Great Pyramid of Egypt, let us imagine a vast space, covered over with huge blocks of rock brought from the mountains across the valley of the Nile, over a causeway prepared for the purpose, which preparatory work, according to Herodotus, took 100,000 men ten years to accomplish.

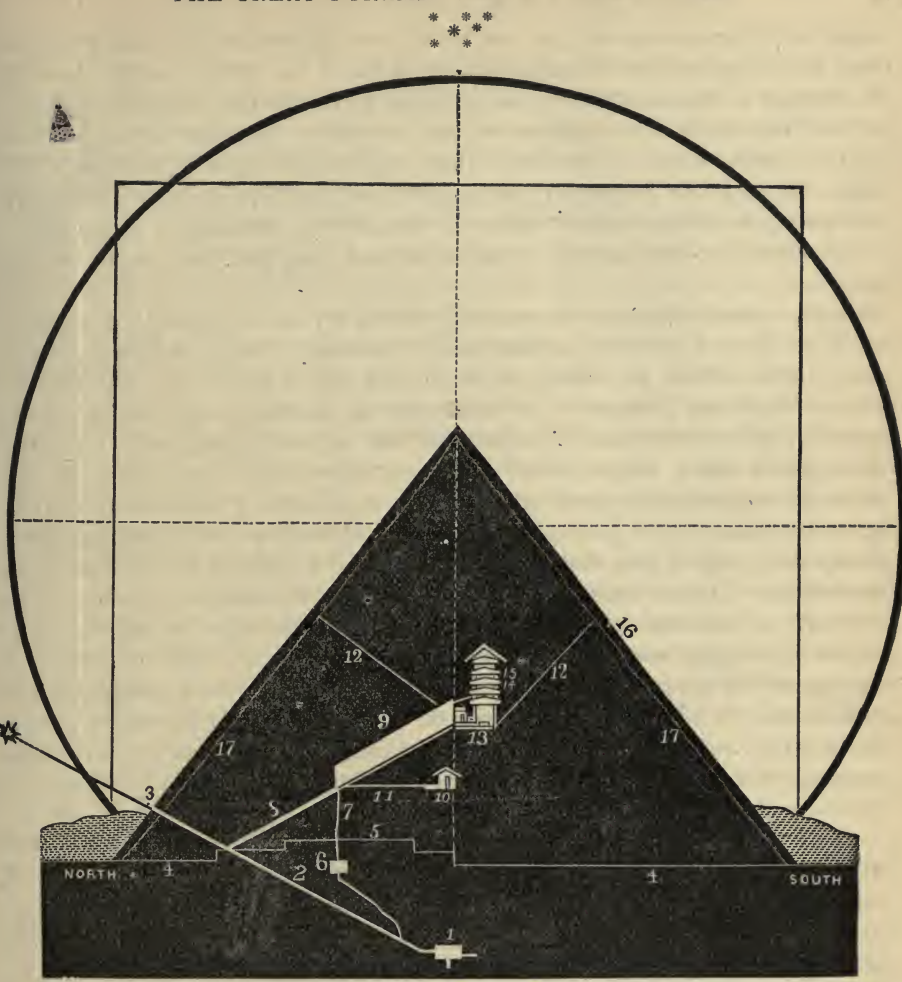
This army of laborers lay off a thirteen acre field, and begin to arrange the rocks in rows, not only all around it, but all over it, filling in all crevices till it is one solid mass. Then they pile a second layer over the first, and a third over the second, and so on till they get as high as the tall forest trees, say eighty feet in height. Then they build on till they reach double that height, one hundred and sixty feet; then till they treble it, two hundred and forty feet; then till they quadruple it, three hundred and twenty feet. They continue to ascend, day by day, week by week, month by month and year by year till they rise higher by far than the tallest steeple in the world, till they reach a height more than a third as high as a forty acre field would be if turned up edgewise. The base of this

immense structure is more than half a mile around, and when a man stands on the top he cannot throw a stone half way to the outside of the base. This faint description may convey some idea of the hugeness of this structure, and what gave it the rightful claim to be classed first among the seven wonders of the world. There it stands to-day as it stood before the days of Moses or Abraham, older than history either profane or sacred, over four thousand years old, the oldest, the tallest, the most solid and substantial building on the earth.

We shall be excused if we stand awhile and tarry and gaze at this wonder, and take time to grapple with the questions *When*, and *How*, and *Why* was this structure erected. If the statements published to the world are to be credited there are newly discovered wonders in that artificial "Rocky Mountain," by the side of which what we have been considering shrink into almost inconceivable littleness. I refer particularly to the discoveries of Prof. Piazzi Smyth, Astronomer Royal for Scotland, Sir John Herschel, Col. Howard Vyce, John Taylor, Wm. Petrea, and others. I am aware that some of the theories and claims of these men are regarded as more chimerical than substantial. Nor do I wonder that scientists, confirmed in preconceived notions which are adverse to these discoveries, should, upon their first announcement, regard them as sheer nonsense, the fancies of a one-idea brain, and that in their offended prejudices against what at first sight appears absolutely absurd they should turn from the subject with disgust as absolutely unworthy the attention of scholars. But admit the facts which we propose in this paper to demonstrate, and with Prof. Smyth they must acknowledge that "the Great Pyramid is the highest and holiest subject that can ever occupy the attention of a scientific society," The new American Cyclopædia (a standard authority and a library in itself) in its article on this subject notices Prof. Smyth's theory and his claims, (that astronomical problems and metrical systems are memorialized in the Great Pyramid). But it disposes of these claims very summarily by declaring that they were not supported by hieroglyphic inscriptions, nor the testimony of the ancients. Of course they were not. This is a most important admission. But is it scholarly to discard facts because of recent discovery? I shall now treat the problems in this venerable structure with such figures and forms of expression as seem most adapted to convince, not in the order of their discovery or importance, but in the way most likely to attract attention, till the beholders are anchored in its intricacies and compelled to consider its tremendous facts.

PROBLEM I. *The perimeter of the Pyramid equals the periphery of a circle whose radius is the vertical height of the Pyramid.* (For illustration see figure.)

Now if we take a point directly under the apex of the Pyramid, at its square base, and describe a circle with the height of the Pyramid as our radius, we do precisely the reverse but the full equivalent of squaring the circle. The height of the Pyramid is 5813 inches; the length of one side is 9131 inches. To obtain the perimeter of the Pyramid we multiply the length of one side by four, its number of sides. To obtain the periphery of the circle we double the radius and



PYR-MET or PYRAMID.

1. Lower chamber. 2. Descending passage. 3. Entrance. 4. Natural rock platform. 5. Natural rock elevation. 6. Cavern. 7. Well hole. 8. Ascending passage. 9. Great Gallery. 10. Queen's Chamber. 11. Passage from the Great Gallery to Queen's Chamber. 12. Passage for ventilation. 13. King's Chamber. 14,15. Small apartments above King's Chamber. 16. Outer surface with casing. 17. Outer surface with casing removed.

multiply it by the figures designated by mathematicians as *pi*, Greek p, viz: 3.14159, and we have thus, 9131x4=36524; 5813x2=11626x3.14159=36524.-12534. Admit the possibility of a human error in the measurement of the Pyramid of less than one-tenth of an inch on each side, and we have precision which is as near perfection as human skill ever approaches.

I digress here for a moment, simply to call attention, as we pass on, to these figures 36524.12534. Mark how suggestive they are on the circle of the number of diurnal revolutions of the earth, or days, during one annual revolution, or year, with precisely one hundred inches to a day, exhibiting at a glance a ten-division system for the measure of time. (See figure.) The problem just illus-

trated involving the squaring of the circle, was discovered by a man who had never seen the Pyramid himself, but only charts of it. He saw in the slope of the Pyramid a very peculiar and intricate angle to work by, viz: 51° 51′ 14.3″. He used this angle in connection with a base side to calculate the height, and saw that the most minute variation of this angle would augment or diminish the height. This led to the inquiry, why was it built just so high when it required such an inconvenient angle to work by, unless it was necessary to accomplish a certain design? The peculiar proportions soon suggested the answer to the inquiry.

The Greek philosopher who ran through the city crying *Eureka!* on the solving of his intricate problem, was not more overwhelmed with emotion than was John Taylor when he found *pi* or the modern method of squaring the circle in the Great Pyramid. He published his discovery, and men of brains marveled, and still they marvel. And well they may, for the solution of this problem involves others more intricate and more marvelous. The *pi* is found here by the rule of proportion thus: As the height is to half the perimeter, so is 1 to *pi*, 5813: 18262.1 : : 1 : 3.14159. It is so simple when we see it that we do not wonder that John Taylor found it there. But the wonder is, *who had the genius to put it there?* It was there by accident or design. No scholar regards it as an accident. *Pi* reveals as much design as a watch does, and it would not be as reasonable to regard a watch as a creature of accident as *pi*. But for what was it designed? Certainly not for the benefit of the people then living, for it is admitted that it was not then discovered. (See American Cyclopædia, article Pyramids). Prof. Piazzi Smyth, and some others, give us their answer to this question. We wait for scientists to give us a more consistent one if they can.

Problem II. *The distance of the sun from the earth, divided by twice the Pyramid's height equals the earth's polar diameter.*

This I have evolved out of a problem discovered by Wm. Petrea, civil engineer. I state this in this form to exhibit at first view the correlations of the sun, the earth and the Pyramid to each other. Now the earth's polar diameter, according to our late school books, is 7899 even miles without counting the fraction. But the Pyramid had it 7899.56 miles over four thousand years ago by dividing the sun's distance, 91,840,270 miles, by twice the Pyramid's height, 11,626. 91,840,270÷11,626=7,899.56. This is precise enough. But where in the Pyramid do we obtain the 91,840,270 miles as the sun's mean distance from the earth? We will explain. The vertical height of the Pyramid, multiplied by the number which its peculiar geometrical shape symbolizes, *i. e.* ten raised to the ninth power (1,000,000,000), equals the sun's distance from the earth. Now any number divided by *twice* the height, equals *half* that number divided by *once* the height. This is equivalent to 45,930,135÷5813=7899.56, as before. The Pyramid's shape is such that beginning at the apex and measuring downward, for every ten feet of perpendicular descent it expands nine feet horizontally. Hence the claim that it symbolizes ten raised to the ninth power as one of the factors in calculating the

sun's distance. The height of the Pyramid is 5,819 English inches, which multiplied by 1,000,000,000, (ten raised to the ninth power), equals 5,819,000,000 inches, or 91,840,270 miles for the sun's mean distance from the earth. The ancients estimated the distance of the sun from the earth at 10 miles; it was increased afterward to 10,000 miles; then it ran up to 2,500,000 miles; it then took another leap to 36,000,000 miles; again it was estimated at 75,000,000 miles; early in this century it reached 95,000,000 miles; then it decreased to 91,500,000 miles; again it increased to 92,500,000 miles; now it is estimated at 91,840,000 miles. This last estimate is that of M. Puiseux, a French astronomer, made since the last transit of Venus, when the solar parallax calculated from observations in China and the Indian ocean, was determined at 8,879 seconds of a degree. M. Puiseux thinks it improbable that there can be an error in his calculations which will reach the second fractional figure, (7).. This calculation must therefore approximate exactness. Present astronomical science, under the most advantageous circumstances, by the aid of the most exquisitely wrought and improved astronomical and mathematical instruments, including telescopes, azimuth compasses, equatorials, transit instruments, regulator clocks, etc., together with the aid of the present day astronomical knowledge of the Universities of the world, in round numbers, without presuming to run down to the precis-ness of hundreds and tens, in numbers of such great magnitude, says that the sun's distance from the earth is 91,840,000 miles. And the Pyramid said it was 91,840,270 miles, without any of these aids in calculating and before any of them were invented. A French paper, the *Les Mondes*, on the announcement of M. Puiseux' estimate, exclaims, "*La Grande Pyramide a vaincu.*" The Great Pyramid has conquered. I confess to a shock coming over me like that occasioned by a clap of thunder when I made and compared these estimates, and saw an exactness which suggests superhuman knowledge in the architect of the Great Pyramid, and in its correlations, not only to the earth, but to the solar system, and extending even to the system around which ours revolves.

Prof. Piazzi Smyth's theory is that the Great Pyramid was planned by inspiration, as was the case with the ark, the tabernacle and the temple; and that it bears a relation to science similar to that of the Bible to Christianity, and that it was designed as a symbolism of geographical and astronomical correlations to our earth, so accurate as to demonstrate a harmony between science and religion in our day when such a demonstration is very desirable. We know that man's works never attain perfection at once, that always and everywhere there is a gradual advance from the crude to the more accurate and beautiful, and that better styles of architecture are preceded by those less advanced. But in the Great Pyramid all of these laws are reversed, and the best is presented first. For no other pyramid has any of these symbolisms, although they were evidently constructed after this pattern so far as the builders understood it and were able to imitate it. It is a sudden presentation of perfection in scientific knowledge in advance of *means* for obtaining it, monumentally commemorated. Egypt had no *scholars* then nor afterward. Renan says that "not a reformer nor a great

poet, not a great artist, not a savant, not a philosopher is to be met with in all their history." Brugsch says that what astronomical knowledge the Egyptians had "was based on empiricism and not on that mathematical science which calculates the movements of the stars." There is nothing that even suggests the *evolution* theory in the Great Pyramid. Osborn says, "It bursts upon us in the flower of its highest perfection." Dr. Seiss says, "It suddenly takes its place in the world in all its matchless magnificence, and as clear apart from all evolution as if it had dropped down from the unknown heavens." Renan says, "It has no archaic epoch." Now how shall we account for all this? Those who are living in the past, who think it unreasonable to overturn old theories with new facts, may be satisfied with dismissing at once what was not supported by the ancients. Those who are too timid to grapple with difficulties, may be satisfied with looking them squarely in the face and then passing on, as a certain preacher managed hard texts of scripture. And ridicule may suit the superficial and thoughtless. But practical, persistent, logical thinkers require an intelligent answer. Prof. Smyth accounts for it on the inspiration theory. This is one solution of the difficulty. If scientists have any better solution let them advance it Many people are holding their judgments in abeyance, waiting for a sensible reply.

PROBLEM III. *The Pyramid symbolises a cycle of our solar system around a very remote centre.*

This it does by its star pointings and was discovered before the problems already demonstrated. Sir John Herschel, who was ever on the alert to rival as an astronomer, his distinguished father, (the discoverer of Uranus and the nebulous theory) noticed the peculiar entrance to the Pyramid, fifty feet up, so high from its base as to make it extremely difficult to enter, and he wrestled with the query, why such a peculiar entrance? His cultivated genius soon discovered that the angle of declination in that entrance was precisely that of the earth on its polar axis, and that about the time the Pyramid was supposed to have been built, there was a very peculiar stellar combination. He learned very soon, by astronomical calculations, that the North star of that period, called Draconis, pointed exactly down that entrance, while on the meridian of its extremely small axis, precisely at the time when the Pyramid, with its sharp pointed apex, was pointing to the star Alcyone, the principal and centre star of Pleiades, known among the common people as the seven stars. This very peculiar and exceedingly interesting combination of star correlations too marked the beginning of a cycle, which will end with a complete revolution of our solar system around the Pleiades in 25,868 years from that time. Herschel concluded from the close proximity in time of this remarkable stellar combination to the time when the Pyramid was built, according to the most authentic testimony, and from the seeming fitness in having such an event memorialized, that it was finished on that occasion. Recently discovered chronological marks in that entrance passage way of the Pyramid are said to corroborate the conclusion of this distinguished astronomer on that point.

There is another very singular coincidence worthy of notice in these cele-

brated star pointings. The star Draconis, which points down that dreary, slippery, obscure passage, which extends far below the foundation of the structure into the "blackness of darkness forever" where no sunlight ever reaches, signifies Dragon, while Alcyone, the star toward which the apex (the *chief* corner stone and *head* stone of the corner) points, on which the sun shines on all sides at once, is in Greek, Halcyon, signifying peaceful, happy. When we reach the discussion on the harmony between revelation and science we may have occasion to refer to what infidels call Bible contradictions on astronomical subjects. For example, in the oldest book of the Bible, Job states an unvarnished scientific fact when he says, "God hangeth the world upon nothing." (Job 26, 7). But God speaks to Job about laying the foundations and measures, and stretching a line upon it, and at last clapping on a corner stone, on which occasion the morning stars sung and the sons of God shouted. He tells him also of the "sweet influence of Pleiades." Now whoever cannot reconcile this highly figurative declaration to such a symbolism of the earth as then stood in all its primeval comeliness without doing violence to the same fact stated scientifically by Job himself, has not sufficient capacity to appreciate either sublimity in eloquence or beauty in poetry.

The American Cyclopædia in its article on astronomy says, "We may accept Prof. Smyth's conclusion that the building of the Pyramid corresponded to the time when the star Draconis, at its upper transit, was visible, (as well by day as by night) through the long inclined passage which forms one of the characteristic features of the Pyramid. This would set the epoch about the year B. C. 2170. And it is a remarkable fact, that as Prof. Smyth points out, the Pleiades were at that time in a most peculiar position, well worthy of being monumentally commemorated, for they were actually at the commencing point of all right ascensions, or at the very beginning of running that great round of stellar chronological mensuration which takes 25,868 years to return into itself again, and has been called elsewhere for reasons derived from far other studies than anything hitherto connected with the Pyramid, *the great years of the Pleiades*" This article adds, "But although we may thus set the astronomical system of the Egyptians in a far antiquity, it seems unsafe to follow Smyth in believing that the builders of the Great Pyramid were acquainted with the sun's distance, with the true length of the processional period, and with other astronomical elements, the discovery of which has rewarded the exact methods and the profound mathematical researches of modern times." I would ask then the stunning question of a modern genius, What are you going to do about it? What theory have scientists to advance which will harmonize their own admissions? The inspiration theory does not involve the difficulty that the Egyptians knew, what *we now* know about astronomy. Was it necessary in the erection of the temple that the builders should have understood the design of the architect? The inference that a building erected implies on the part of the workman a knowledge of the design of the architect, whether inspired or uninspired, is not warranted by the logic of facts, nor the logic of reason.

PROBLEM IV. *The Pyramid presents a symbolical ten-division metrical system.*

To this department of the Pyramid's symbolism we cannot present a parallel offered by science. Man's inventive genius has not produced a system of measures that for convenience or correctness will compare with it. The bungling, inconvenient systems now in use are as far behind the Pyramid system as the old way of numbering by letters was behind the present method of numbering by figures. The French government has adopted a ten-division metrical system with a unit of linear measure called a meter. This meter is obtained by dividing the distance in inches from the equator to either pole of the earth into 10,000,000 equal parts, and taking one of these divisions or meters as the most convenient measuring rod, corresponding somewhat to our yard stick. This unit is an odd number and a fraction reduced to decimals extended to five decimal figures, "and still there's more to follow," viz: 39.37079 inches to represent a unit or one. It is admitted that by geodetic measurements, up to 1875, this unit or one falls short of its definition by $\frac{1}{5400}$ part; so that it lacks by so much the merit of being correct. (See American Cyclopædia). They take the exact $\frac{1}{10000000}$ of an erroneous number in order to obtain such an awkward indivisible number as 39, with five decimal figures 37079, as a caudal appendage, curtailed at that, from the standard unit of one of linear measurement. And that is the triumphant attainment of *science* in this direction! Like other fashions of similar origin, other nations are adopting it, and some scientists are recommending it for *universal* adoption. Merciful Heaven! Deliver us! Another system, much more simple, has recently been presented for the consideration of the Congress of the United States by Hon. Alexander H. Stevens, of Georgia. Its linear table reads thus:

100 hairs = a nail.
100 nails = a meter.
1000 meters = a kilo.

This lacks the important qualification of definiteness in its unit, which is just about as precise as a piece of chalk. Now the Pyramid presents us with a measuring rule without any of the above named defects. Its length is twenty-five Pyramid inches, or 25.025 English inches, numbers easily adjusted to each other. This twenty-five inch rule has the merit of being the *true* $\frac{1}{10000000}$ of the distance from the centre of the earth to either pole. This, therefore, is in exact proportion to the polar diameter that the French meter *pretends* to be to the earth's polar circumference, with the additional advantage of a straight line through the earth, instead of a crooked one around it, as its standard of straight linear measurement. The distance from the centre of the earth to either pole, as we have shown, is 250,000,000 Pyramid inches, or 250,250,000 English inches, which divided into 10,000,000 equal parts make as its unit of measure 25 Pyramid inches or 25.025 English inches. The inch of the Pyramid is about half the width of a fine hair longer than the English inch. It requires no great stretch of credulity to believe that the Pyramid inch was the measure from which our English inch originated. The marvel is that after the wear incident to the changes of more than four thousand years the difference now should be no greater. The French table of linear measure is founded thus:

39.37079 inches = 1 meter.
10 meters (363.7079) = 1 decameter.
10 decameters (3637.079) = 1 hectameter.
10 hectometers (36370.79) = 1 kilometer.
10 kilometers (363707.9) = 1 myriameter.
$\frac{1}{10}$ = a decameter.
$\frac{1}{100}$ = a centimeter.
$\frac{1}{1000}$ = a millimeter.

Now by the side of this monstrous jaw-breaking combination of terms, incapable of being understood except by classical scholars, and incorrect besides, let us place a table of linear measurement which we will draw out of the Pyramid. The name Pyramid, like other oriental names of olden times, had a signification. According to the opinion of Chevalier Bunsen, an oriental scholar and one of Prussia's ablest scientists, *pyr* in the old Coptic language signified division. The *peres* in Dan. 5 : 28, was from the same root. And *met* signified ten. By combining these words we have *pyr–met*, which signifies ten divisions, and which comes nearer the present day spelling and pronunciation of pyramid than many English words now do to their originals. So pyr–met, or pyramid, symbolises in its name its own ten-division metrical system. In the carefully marked measures of the interior of the Pyramid the shortest linear measure is one-tenth of an inch. As pyr means division, this is the pyr or division of an inch, and it takes ten of them to make an inch. This gives us a start. We will proceed and see what we get, thus:

10 pyrs = 1 inch.
10 inches = 1 met = 10 inches.
25 inches or 2½ mets = 1 cubit = 25 inches.
10 mets or 4 cubits = 1 meter = 100 inches.

Sir Isaac Newton said that the cubit that Moses and Solomon used, called the sacred cubit, was about twenty-five inches. The cubit of the Pyramid is the same. It is about the length of a carpenter's rule or iron square, while the meter would be near the length of an eight foot pole, both very convenient measuring rods. We would need to add something to correspond as a ten-division number to one mile perhaps, thus:

1000 cubits = 1 cubit mile, or
1000 meters = 1 mille,

and we have a table not only wonderfully adapted to the round ten-division numbers of the geographical and astronomical measurements to which we have referred, but a table so simple that a child who could count a hundred would understand it, and it would be amply sufficient for all the computations by logarithms or otherwise, of the most profound mathematicians. The 2½ mets to a cubit is the equivalent in linear measure to the 2½ dimes to a quarter of a dollar in our money measure; and one is about as indispensable for convenience as the other.

Sir John Herschel has advocated very strongly the metrical system which he

saw in the Pyramid as immensely superior to the French system now so widely used. Pres. Bernard says if the French metrical system had to be created anew, its promoters would profit by what is now known. A French mathematician, M. Callet, as early as 1795, long before the discovery of this peculiar cubit of twenty-five pyramid inches, recommended the adoption of exactly twice this length as a suitable unit of measure. In his book on logarithms he suggested the even $\frac{1}{10000000}$ of the earth's polar diameter as the standard with which to compare all distances and lengths. The pyramid system takes the even $\frac{1}{10000000}$ of the earth's *half* polar diameter, while the French system professes to take the even $\frac{1}{10000000}$ of the earth's half polar circumference.

The American Cyclopædia in its article on weights and measures says that "The only standard which may contend with the French meter for universal adoption is the English inch, which is almost exactly $\frac{1}{500000000}$ of the earth's polar axis, and that the English inch may therefore very properly be regarded as natural a standard as the French meter; and that by slight changes of the inch, this relation might be made exact to the $\frac{1}{500000000}$ of the earth's polar axis, and that twenty-five of such inches making a cubit, would be equal to the $\frac{1}{10000000}$ part of the earth's polar axis." This is the pyramid system exactly, without the slightest variation. And the exact changes suggested would be made by adopting the exact pyramid inch. Is it possible that the writer of this article on weights and measures actually advocated the pyramid system (thinking it was original) as the only system that would ever compete with the French system for universal adoption? Did he not know that he was recommending precisely one of the lessons taught in the Great Pyramid?

The architect of the Pyramid not only knew the shape of the earth and how to measure its surface and diameter, but he knew what it would weigh if it were possible to put it on scales sufficient for that purpose. And strange to say, its weight is correlated to the weight of the Great Pyramid, as appears thus: There is a unit of weight measure in the Pyramid where a cubit inch of average earth, *i. e.* earth at its mean density, is estimated to weigh 5.7 times as much as the same quantity of water at 50° of heat at its own thermal measure. This corresponds very well to the present scientific standard. At this estimate the Pyramid's weight and the earth's weight are respectively thus: Pyramid, 5,272,600 tons, earth, 5,271,900,000,000,000,000,000.

It will be seen at a glance that if this estimate, made by a competent civil engineer, William Petrea, is correct, that the weight of the Pyramid is almost the even one quadrillionth, or thousand-million-millionth ($\frac{1}{1,000,000,000,000,000}$) of the weight of the earth. It is remarkably near it, for the Pyramid has only 700 tons, or a small vessel load, too much to make the measure exact. This is a proportion to such a mass, which is no more than that of the drop to the bucket. If reasonable allowance were to be made for a minute human error, which extended only to the fractions of the numbers which are the factors in the multiple of the earth's weight, it would be sufficient to produce exactness.

It will be seen that this method of measuring solids by the weight of water,

establishes proportionate relations between solid and liquid measures, so that the inter-relations would be, it is said, thus:

1 drop of water = 1 grain.
1 pint = 1 pound.
1 bushel = 1 hundred weight.
1 chaldron = 1 ton.
5 cubic inches of earth = 1 Pyramid pound,

which varies but a trifle from the pound avoirdupois.

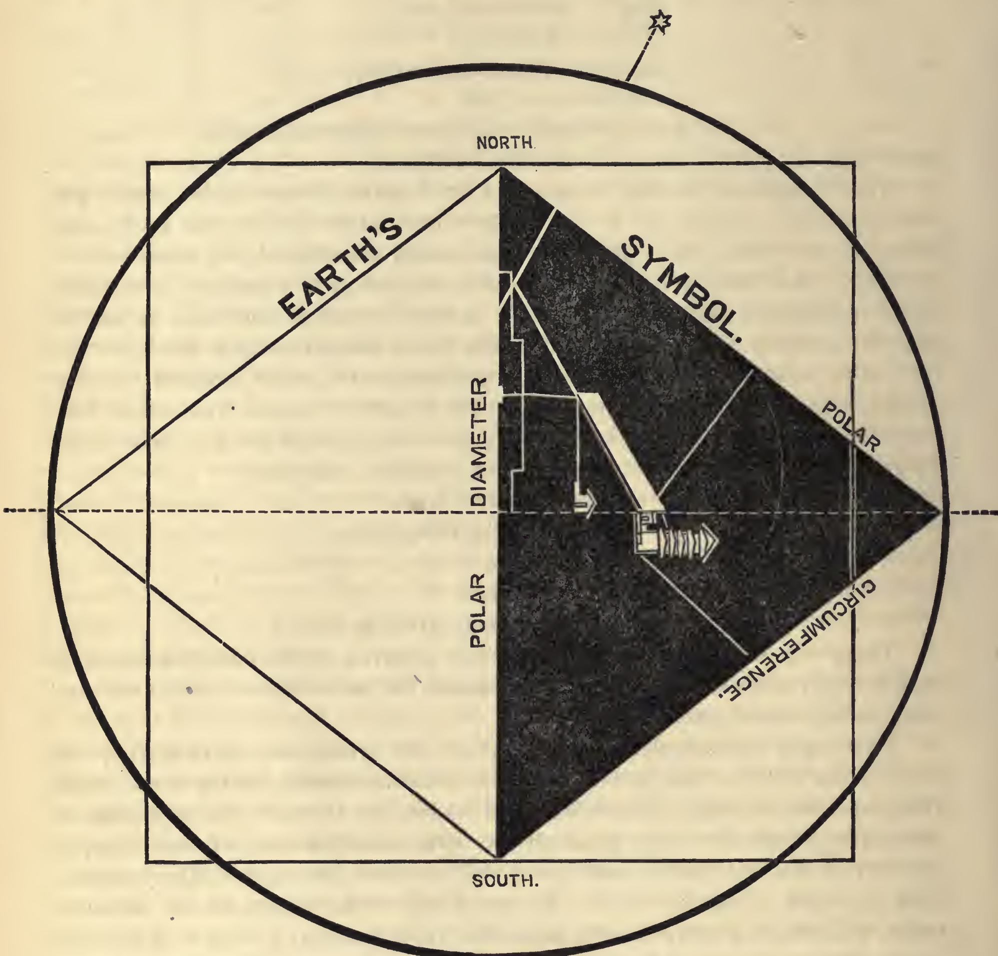
The Thermal ten-division measure of the Pyramid is remarkably simple and comprehensive. It fixes 0° as the mark where water freezes, and 250° as the boiling point. Then, even 50°, which is exactly one-fifth of the distance from freezing point to boiling point, and which is equivalent to about 68° Fahrenheit, is that comfortable degree between heat and cold which is said to be the earth's mean temperature. This 50° point is the exact temperature of the Pyramid's Holy Place, a chamber aired by two ventilators, with walls polished like fine jewelry, where it is said are found the counterparts to sacred symbols in Solomon's Temple, and where the temperature never varies from 50° from one end of the year to another. The table for Thermal measure runs thus:

0° = zero—water freezes.
50° = earth's mean temperature.
250° = water boils.
1000° = iron red hot.
5000° = platinum melts at white heat.

Those who contend that the Holy Place referred to was intended for a sepulchre, might exercise their reasoning powers on the design of ventilators and other peculiar arrangements in a tomb.

This paper has extended far enough for one article, but there is either too much or too little in the problems we have demonstrated, to stop it suddenly. They leave our curiosity unsatisfied, and incline us to walk in and explore its avenues and chambers, its exquisitely accurate measures and workmanship, so perfect that the best optical instruments fail to show defects, and where stone is fitted to stone of exactly equal size, and joined with cement as fine as silver paper, and where it is said can be found the exact pattern of the ark of the covenant of Moses, declared by divine inspiration to have been made after a pattern shown in the Mount, by Jehovah, and not after the then existing pattern, which was like it, but sealed from human view till thousands of years afterwards.

If desired, we may at another time examine, to the best of our abilitv, some of the inside problems, less likely to be fully understood, which it is claimed involve not only science but revelation, including prophecy—subjects too momentous to be disposed of hastily or carelessly. In the meantime, why will not honest and intelligent unbelievers, especially of the evolution stripe, speak out, and give us from their stand-point a reasonable, scientific solution of the problems, which appear now so prominently on the outside of this huge old monumental wonder.



Since the discovery, about forty years ago, in Egypt of two zodiacs, reported by French astronomers to have been used by primitive man, one of them some 17,000 years before the Christian era, and which afterwards, by undoubted testimony on the instruments themselves, were proved to have been made during the reigns, respectively, of Antoninus and Nero, scientists of the skeptical school seem disposed to ignore new scientific discoveries in that country, no matter how important, and at least to steer clear of Egypt.

VESUVIUS AND THE SURROUNDING COUNTRY.

(*Visited March 10th—19th, 1876.*)

BY PROF. C. E. CROSBY, KANSAS CITY, MO.

One hundred and twenty-five miles south-east of Rome stretches Campagna, bounded on the north by the Pontine marshes, on the south by the mountains of Calabria, on the east by the foot-hills of the Appenines and on the west by a translucent sea. Upon this level plain are two objects of interest which will claim our attention: one, Vesuvius, a low, solitary mountain by the sea, bounding from a handsome shore to the height of 4,257 feet; the other, a tract of country nearly five miles square and ten miles distant from the volcano. It will be convenient to first consider the general history and character of the latter.

Setting out afoot from Naples (pop. 415,000), a city of the greatest wealth, poverty and population in Southern Italy, one fails not to notice the peculiar soil, the strange color and the stranger texture of the rocks along his way. No sooner is this brown tufa rock seen—a specimen of which is upon the table before you—than his mind, seeking its origin, wanders far back into the unwritten past, when the Mediterranean not only covered the place of his observation but spread away eastward until it washed the feet of the snow-capped Appenines. In that distant age the back-bone of Italy was unbroken from the Alps to Sicily, but this country, so full of scientific as well as historic interest, was then only a back-bone. While surveying the evidences in silence, he images Vesuvius convulsively rising from the temperate. Cænozoic sea, tens of thousands of years before the mysterious Sibylline books were carried from Cumæ, whose ruins are almost indistinguishable before him. He knows this tufa to be only the sediment of the red-hot cinder-shower that poured from that early Vesuvius. During the same epoch the site of the Imperial city lay under the tepid sea, whose waters were blackened with the volcanic shower from the neighboring Alban and Cimmian hills. In subsequent centuries the Roman Campagna, with its rich beds of puzzuolane earth—which alone gave durability to the famous Roman cement—and the Campagna about Naples were raised into the sunlight. This account of the formation of tufa becomes more probable, knowing that Signor Guiscardi has collected from the tufa hills of Pausillipo more than an hundred species of shells, but a few of which differ from those now inhabiting the waters that lave the adjacent shores.

That you might better understand the form of Vesuvius and the character of the surrounding country, I have prepared, at a considerable expense of time, a plaster of Paris model of them for a radius of nearly twelve miles. [Prepared from a map by Prof. Phillips, of Oxford, in connection with my own observations.] For the present you will observe this tract, called by the early poets the Phlægrean Fields, lying just west of Naples and literally covered with craters, varying from fifty to five hundred feet in height. Under the varied influences of bright sunshine, fierce internal heat, drenching rain, a balmy air, and a destruct-

ive vegetation, they have descended to us in all stages of perfection, from those whose outlines are barely traceable to those of perfect crateral form, and all are extinct but one. I wonder that so interesting a country is not better known. Here is Monte Nuovo, 456 feet high, an eruption of 1538 and the last upon record in this part of the Campagna. Its sides are covered with scoriæ and blocks of trachyte, and its oval interior is but nineteen feet above the sea. This is Monte Barbaro, celebrated by Juvenal for its excellent wines. Its crater is a mile in diameter and its sides are covered with a vegetation of myrtle, arbutus and wild evergreen, but the activities that raised it are so remote as to span the whole reach of human history. To the north of these are the striking forms of Monte Grillo, Fossa Lupara, and others, but their paroxysms are buried in the deep past. I can only mention Astroni, whose crater is three and a half miles in circumference, around which are discovered only volcanic ashes and mud: its splendid form and interior vertical cliffs unmistakably indicate that where now "the wild boar and wary deer roam amid forests of oak and ilex, slaking their thirst in small lakes half covered with water lilies," was formerly the place of great volcanic disturbance, which, although unseen, is none the less certain. Farthest to the north is the Piano di Quarto, the longer axis of whose crater is but a little less than four miles. A little back of Naples is the Pianura, which, although smaller than the last, yet dwarfs that of the present Vesuvius almost to insignificance. I have said that, with a single exception, these craters are extinct, still, in many places throughout the Phlægrean fields the stranger fails not to discover heat that is not "latent" and volcanic products that are not ancient. From hundreds of crevices long, thin streams of steam, perceptibly hot, constantly pour from the ominous depths from which are deposited beautiful incrustations of sulphur and the deeply contrasted red arsenic sulphide. I must call your attention to this crater, the Lago di Agnano, for not only did it attract the notice of the ancients, but, throughout the long night of the Middle Ages it was an object of curious superstition. It is not a lake, as its name would indicate, as, twenty-five years ago it was drained by an Italian engineer, and now, within its tree-clad cliffs, it presents but little else than a beautiful meadow where graze many flocks of sheep. Within the crater, on the eastern side, the infamous Tiberius built his royal palace by a mineral spring, whose temperature to-day is 180° and nauseous with hydrogen sulphide, while near these ruins, in the crannies of the rocks a few yards away, pure sulphur is being deposited.

But the point of greatest interest is the *Grotto del Cane* (Grotto of the dog), noticed 1800 years ago by Pliny in his scientific writings and not less full of meaning for us. Before leaving Naples I provided myself with waxen strings, not knowing that the grotto was in charge of an Italian who asks all he can get for allowing a person to examine it. I can do no better than transcribe my journal. The cavern, located in the side of the crater, is four feet wide and ten feet high, the floor rapidly inclining from the entrance. The rocks are quite warm, but endurable, and one's feet are soon damp with perspiration. When the door was opened, I noticed a white smoke, a foot deep, pouring out into the plain

(crater)--probably the vapor of water. Advancing a couple of steps into the grotto and lowering the taper to my knees, it was instantly extinguished. With a flambeau of hemp I advanced still farther in the grotto, then, upon lowering it until immersed into the stream of suffocating gas, it was extinguished as quickly as if plunged into a stream of water. Relighting and going still farther into the cave, upon lowering it it was again put out at the height of my shoulder—thus proving that I was standing shoulder deep in the carbonic acid stream which, for twenty centuries has been pouring its floods of death out upon the floor of the great crater. Knowing its ultimate effect upon life, I wished to ascertain how a smaller quantity would affect a person. Telling the keeper that I wished to breathe it, he followed me into the grotto. Burying my head in the invisible gas without breathing it, I felt no peculiar sensation and upon taking a small draught of it into my lungs, I noticed only that the air was a little "close." I then tried two deep inspirations, which produced a roaring in my ears and a dull, boozy feeling in my head, neither of which were painful. Although my vision was perfect, my eyes felt dull and the eyelids heavy. Expelling the gas from my lungs, it was difficult for a minute or two to feel any satisfaction from breathing the fresh open air. I was not satisfied, still, I did not think it prudent to experiment further. The Italian's jolly wife said that a dog would become insensible in a minute and a half—consideration one franc. While holding the watch, the dog was lowered into the stream. In thirty-five seconds its eyes rolled wildly and I ordered it out. Recovering quickly in the fresh air, it was again lowered into the gas, and in fifty-five seconds the animal reeled, but he would not take it out as I ordered, leaving it until it fell, one minute and ten seconds after its immersion. When taken out and laid upon the grass, its body was limber and its eyes were closed. In one minute snuffing and choking commenced, followed by awkward efforts to regain its feet. Soon it moped slowly away and was again capering with its companions on the lawn. The fact is these dogs have been killed so many times for the benefit of travellers that they seem to enjoy it. There is but one explanation of this phenomenon; deep down in the earth's bosom the internal fires warm and decompose the limestones driving off this river of Carbonic Acid. Eleven twenty-fifths of weight of common limestone is this invisible and irrespirable gas, or, forty four pounds in every hundred pounds of rock. The amount of gas thus expelled from the deep subterranean rocks, consequently, the amount of rock chemically and physically changed since the superficial observations of Pliny were made, must be enormous. Thus we have an explanation of the Guevo Upas in Java, or Valley of Poison, a half mile in circumference. It is an extinct crater, strewn with the "carcases of tigers, deer, birds and bones of men," caused by the constant flow of carbonic gas into it. It is no wonder that the crater, Lago Aguano, when filled with water and, as during the Middle Ages, probably covered with carbonic acid gas, should have been the source of much superstition. With still greater force was this true when neither the existence nor the properties of the gas were known, when philosophy was empty theory, and a rigid investigation of facts, which alone determines their principles, a thought that had not

taken hold of the minds of men; and to-day not a few delude themselves in vain efforts to grapple with some of the great scientific questions, absolutely if not professedly ignorant of the simplest details and elementary principles upon which they are claimed to rest.

The craters of the Phlægrean district have consumed much of our time, but I would not omit the most interesting—the Solfatora. It is especially interesting from the fact that from it has flowed the only stream of lava known to the west of Naples. This crater is an elliptical basin of several hundred acres bound by walls one hundred and twenty-five feet high. A path leads across the center to the opposite side, many rods of which echo to the walk as if great subterranean chambers were beneath. The guide picked up a thirty pound boulder and threw it down at my feet, causing the ground to tremble and producing a rumbling not a little startling. Not only under the brier thicket and in the shade of the arbutus was the surface perceptibly warm, but I found several places whose heat could not be endured. Throughout the crater the rocky walls are streaked with yellow, brown, red and white, while the soft floor, mingled with gray and white, abounds with the sulphates of alumina, lime and magnesia. Warned at his entrance, yet he is almost unprepared to witness the strange sight which now meets his eye at the farther end of the crater. Not only does steam, scalding hot, issue from a low, narrow cavern, but the roar of its expulsion is so great that near it, conversation even in a high tone is impossible. For a minute, great volumes pour from the small cavern in torrents, succeeded by short intervals of comparative rest, during which I heard familiar sounds like those of steam escaping from a semifluid substance as heard in boiling corn-mush. The rocks within reach are too hot to be handled and they are uniformly incrusted with bright yellow sulphur and beautiful realgar—the latter by no means plentiful. Stooping low and vigorously using the fifteen foot pole to obtain some specimens, one is apt to venture too far and is liable to get the blast of steam and irrespirable vapors full in his face. Upon the cooled specimens I could distinctly taste alum, and salt upon many of them. Who can work out the complicated reactions taking place in the great laboratory below? Leaving, it is impossible not to turn and look at it again, and it is probable that we now view it with the same mingled feelings of admiration and wonder as were experienced by Strabo (30 B.C.) and his contemporaries. Upon the eastern side hollow sounds are heard beneath the feet, and hundreds of small steam vents attest the existence of great energies not far below. Searching for specimens one frequently burns his fingers and, in not a few places, is it too hot for shoes. The story is authentic and the geologic evidences are unmistakable; eight hundred and eighty years ago the Solfatara was an active volcano; flame and cinders poured upward in torrents, while the air for miles around was laden with impalpable dust through which hurtled the lightning's glare, and a stream of lava flowed a mile toward the sea. The small artificial opening ten feet deep near the centre of the crater, is of no little interest. From the soft plaster-like mud escapes the hot steam with a heavy thud, not unlike that heard when a wagon wheel is drawn from the gutter. This escape is periodical, caus-

ing a great splash and producing an insufferable odor, much like that of sulphureted hydrogen. One has abundant opportunity to look down into it and at the proper time he fails not to use an opportunity to get out of its reach. It is strange that this crater, within a stone's throw of the old Appian and public highway, has not been thoroughly examined; were it in the United States the people would have it all excavated in two weeks, and upon the third would have a nice current of red hot lava flowing into the bay; but these filthy, lazy, intensely religious and ragged Italians take no interest in the matter whatever. Upon analysis of these vapors by Dr. Danberry, of Oxford, he found chlorhydric acid, ammonium chloride, hydrogen sulphide and aqueous vapor, but there seems to be no agreement as to the exact kind of chemical relations which produce them. The citations of ancient authors, tabulated by Prof. Phillips, render it probable that twenty and more centuries ago the Phlægrean Fields were in the same mingled state of activity and repose; and, considering the little interest in the various subjects of natural history, it is no wonder that their philosophy should contemplate in this tract "ominous lakes, hot springs and sulphurous vapors," significant only of conflicts between the giants and gods. I will only mention that this model reminds us of that volcanic tract on the upper "horn" of the half moon whose craters are numerous and whose dimensions are surprising.

Here is Monte Nuova at whose base lies Cumæ, the most ancient of the Greek cities of Italy, and the Lucrine and Avernian lakes. This eruption of the sixteenth century effected many changes in the geography of the district, as villas were overwhelmed, the area of Lucrine lake diminished by one half, the town of Tripergola blown into the air, and every vestige of the wharves of Agrippa were destroyed. Preceding its elevation twenty-seven earthquakes shook the Campagna, an additional two hundred feet of the shore were raised into the warm sunlight, but the miserable and starving poor continued to gather the stranded and struggling life. Soon the volcanic fires broke forth; the heavens were darkened with ashes and cinders; lightnings rent the all but universal gloom and shook the air, and the inhabitants of Puzzuoli, affrighted and petitioning their saints, commenced their wild flight toward Naples, whose palaces, five miles from the eruption, were befouled with the descending mud. At its western base Lake Avernus, nearly circular and surrounded by high steep ridges covered with evergreens and oak trees, seems a deep hollow scooped out of the hills, and were it not for two hundred feet of water its crateral form and origin could not have been mistaken. Lucretius' story that in his time the lake was dark and gloomy and that birds attempting to skim its surface would fall dead by the noxious gases, is not at all improbable when we remember the neighboring Grotta del Cane. It would be difficult to select a more pleasing sight than Avernus, above whose dark unruffled waters sea birds gaily skim the surface beneath an azure dome. At about this point, midway between the two lakes on the right, was the cavernous entrance to the Infernal Regions, where answers were returned by the dead, to which Ulysses came, while in the immediate neighborhood was the abode of the Cimmerians. Of this place did the early poet write

"Dark was the cavern, wide its jaws of rock
By the black lake, and woods of mighty shade."

Not all this is poetic fancy, for the cavern is still there, extending several thousand feet beneath the hills, believed by some unpoetic people to have been only a public road to Cumæ. In a bluff by the sea, a mile beyond the Lucrine lake, are the baths of Nero. Many yards can one penetrate this dark cavern until the steam, scalding with heat, not only stops his progress but again reminds him that the great stores of heat are beneath. Farther to the south are the shores of Baiæ, along which stretched some of the splendid temples and palaces of the ancient world. Strange does it seem, within the roofless temple of Venus whose walls, once of the rarest marble, yet tower to a height of seventy feet, and whose pavement was costly mosaic, to see old broken down wagons and hear the ring of the blacksmith's anvil! Farther are the ruins of Bauli where Nero planned the death of his mother, the rocky Cape Misenum and the Elysian Fields.

On the north shore of the Bay of Baiæ is the ancient town of Puzzuoli. It was here (Puteoli) that St. Paul tarried for seven days, and the more than matricide emperor practiced upon the stage. I can not now describe the ancient amphitheater and the other many things of scientific and historical interest, except to notice the old bath house of the Romans—called in more dignified language the Temple of Jupiter Serapis, from a statue found among its ruins. You must imagine an open area—one hundred and fifteen by one hundred and thirty-four feet—on a level with and near by the sea-shore, strewn with slabs of porphyry, portions of granite and marble pillars with their ruined capitals, the whole surrounded by forty-two compartments, only a few of which are well preserved. Not far from the center of this area are three erect pillars of marble, whose plinth is under water and whose entablature has long been wanting. Its surface is thickly studded with the perforations of lithodomous shells—some of which will admit the little finger—to a height of twenty-three feet. Since its exhumation in the eighteenth century this structure has engaged such scientific minds as Professors Forbes and Babbage, the poet Goethe and Sir Charles Lyell, whose combined researches result in the following conclusions: First, the adjoining Bay of Baiæ, during the last eighteen centuries, has been undergoing a double movement of depression and elevation. Second, this vertical movement has been so gradual as to escape observation. Third, the pillars were bored by mollusks when they were beneath the sea. Many observations along the coast confirm the view that, during the centuries of the past, the country has been rising and falling like the movements of human respiration. It is claimed by a high authority that there is abundant evidence of its having descended two feet within the past hundred and twenty-five years, at which continuous rate the Phlægrean Fields and Compagna may again be submerged hundreds of feet beneath the victorious sea. Evidently there was a time when these waters did not cover so much country for beneath the bay is an old Roman road connecting Pozzuoli and Baiæ. I must only mention the volcanic islands of Procida and Ischia, lying just outside of Cape Misenum, which were settled by the Greeks at a time antedating our own

era by many centuries, but finally abandoned by them on account of the great eruptions. Again they were colonized by Hiero, King of Syracuse, (B. C. 380,) but a fortress having been constructed the volcanic fires were again rekindled when the Greeks abandoned them forever. The last eruption known was in (1302) the fourteenth century, and to-day these rich islands supporting a population of fifty thousand souls, abound with thermal springs, sulphurous fumes, steaming vents and extinct craters.

Let us study the country to the east of Naples. For thirty centuries have Chalcidensians, Oscans, Samnites, Romans, Normans, and Italians successively hovered about the rich Vesuvian slopes, made the Campagna a fruitful garden, filled it with prosperous villages, adorned it with splendid palaces and temples and paved it with excellent roads. To-day, immediately around its thirty mile base, are eighty thousand people, cultivating the soil, clipping the vine, gathering the oil and singing their erotic music in the very clouds of Vesuvian vapor. A description of the physical structure of this volcano is not a little difficult, but this model will give you at a glance an idea of its form and surroundings. Allow me to condense its history. Far back in the past, beyond the farthest reach of written history, Vesuvius was a solitary cone rising out of the Campagna by the sea side. In the war of the Romans against the Samnites, (fourth century B. C.,) when the former sailed up the Sarno, which skirts the eastern base of the mountain they beheld upon its slopes a luxuriant vegetation, and afar toward the crater the vineyards bore their loads of fruit, above which low green shrubs and tangled briers nearly concealed the true character of the underlying soil. An epigram by Martial reads—

> Here verdant vines o'erspread Vesuvius' sides;
> The generous grape here poured her purple tides.

To this place came the Thracian gladiator (B. C. 73) with his brave comrades, having escaped from their bondage at Capua to the north-west. Ascending the mountain by means of bushes twisted together, they lowered themselves into the well-grassed crater. Neither historian nor poet has left a suspicion of smouldering activities beneath the mountain, and not until A. D. 63 did the dense population become aware of the mighty energies beneath them. Then the earthquakes made great openings in the Campagna, destroyed hundreds of sheep, split many statues, killed many people, drove many insane, leveled not a few palaces and laid the historic city of Pompeii in ruins. The sixteen following years passed away with occasional warnings, until the 24th of August, A. D. 79, when, a little after midday, a tree-like column of black smoke poured from the crater for the first time in the annals of history—the world knows the rest. Before the sun had half reached the horizon, midnight darkness prevailed. For eight days lightnings flashed through the universal gloom and torrents of rain fell from the condensing clouds; suffocating fumes poured from a thousand crevices; cinders, ashes, lapilli and mud showered upon the Campagna, burying five cities beneath the liquid mass. Not until recently have the topographical changes effected by that eruption been carefully determined. More than three thousand feet of the upper

part of the cone were blown into the air, and of the remainder, that half toward the sea was torn from its foundation to within sixteen hundred and fifty feet of its base, burying beneath the debris the towns of Oplontia, Teglanum, Stabiae and the considerable cities of Herculaneum and Pompeii. Contrary to what has generally been supposed, neither the surface configuration nor the few accounts of it sustain the view that lava flowed at that time, and for upwards of a thousand years (A. D. 1036) the flow of melted rock was unknown to the inhabitants of Campagna.

What is the present condition of Vesuvius? On sixty-five different occasions has lava flowed from the volcano during the last eighteen hundred years, and more than half of these within the past two hundred and forty years. Among the more important changes is the superposition of a new cone upon the shattered old one, but not sufficiently large to completely take the place occupied by the old one; the result is an open space called the atrium, one-half to three-fourths of a mile wide and three miles long, between the new cone and that part of the old one—called Monte Somma—not destroyed in the first century. So, too, on the side toward the sea the external surface of the new cone is not even with the old base, thus leaving a circular horizontal plane—the Pedimentina—many rods wide and sixteen hundred feet above the sea.

Ascending Vesuvius from the south side one takes great delight in selecting points of interest and admiring the magnificent prospect spread out below him. Eight miles due west of the crater is Naples with its ragged half a million, and from it to Torre del Annunziata, a distance of ten miles along the coast is a continuous village street over which the great black cone towers threateningly. South-west of the volcano at its base by the sea shore, is Herculaneum, buried from seventy to one hundred and twelve feet beneath the present village of Resina by six different streams of lava, and in the same straight line are the thriving towns of Portici, Torre del Greco and Annunziata. Just five miles away to the south-east is the walled city of Pompeii, whose hundred and sixty-one acres, silent beneath its twenty-four feet of ashes and cinders, are but one-third exhumed. Within the limits of history no lava stream has ever reached this celebrated city, although it rests upon an old leucitic current. Near it is the river Sarno, taking its rise in the mountains of Calabria, and a mile to the south-east is the buried city of Stabiæ, where the naturalist Pliny lost his life. From the rocky Cape Misenum, where he had charge of the Roman fleet, he crossed the Bay of Naples to this place where he was suffocated with the sulphurous fumes—his route being indicated upon the plan. Beneath its load of volcanic cinders excavations have furnished numerous papyri, statues and architectural designs, and the present town of Castellammare, above its ruins, is still famous for its carbonated and chalybeated waters. On the western slopes of Vesuvius and nearly half way to the summit is the observatory founded by Melloni in 1844. It is a fine two story structure built of lava and located upon a projection from the Pedimentina, at an altitude of two thousand feet. At present it is under the directorship of Prof. Palmieri, and is well equipped with self-registering instruments, the principal object being to record the phenomena that "precede, co-exist with and follow the eruption."

By various instrumental means the direction, intensity and continuance of the earth movements are recorded with the utmost accuracy and certainty. Long does one gaze from the Pedimentina down upon the Bay of Naples, which, more like an inland sea, washes the feet of the fiery monarch with a liquid azure indescribably soft and beautiful. To the right is Naples, beyond which, upon the hills of Pausilippo, repose the bones of Virgil, the great master of hexameter, whose song beginning

"Tityre, tu patulæ recubans sub tegmine fagi,"

the world will not soon forget. Still farther are the Phlægrean Fields, and forty-six villages of the Campagna, covered with areas of light and shadow that move as noiselessly as the dream of a poet. Southward is Capri with the sinking palaces of Tiberius (erected A. D. 37) covered with and surrounded by the rocky walls of nature's own imperial masonry. Spreading level away with an uninterrupted sweep, and bounded on the southwest by volcanic Ischia and its companion isle Procida, the splendid waters disappear in the open sea. Westward rise rugged mountains, and their beautiful coast is none other than that of Meta and Sorrento extending arrow-like under a dome of lapis lazuli.

Upon this relief I have attempted to represent the streams of the seventeenth, eighteenth and nineteenth centuries, four eruptions belonging to the seventeenth, twenty-three to the eighteenth and twenty-five, thus far, to the nineteenth. So startling is the impression experienced when viewing for the first time these varied and desolate streams, that he who has read the theory and has afterward become practically acquainted with the details of any department of science, well knows the crushing weight of an argument derived from the latter source compared with that of the former. The mental state effected by the study of an *object* is separated by a wide gulf from that condition of mind produced by studying what some one says about it. There is no mistake; literature, history and mathematics for their acquirement require the exercise of fewer intellectual faculties than those of the natural sciences. Worthless is the opinion of that individual, in these latter departments, the development of whose powers of sense—perception, has not kept full pace with that of the judgment and reason. Speaking generally, the streams of the seventeenth century have flowed from the south side of Vesuvius, entering the sea in twelve distinct channels. One of the most memorable eruptions occurred in 1631, after rumblings and earthquakes of six months' duration, when the lava broke forth and poured down the south-western slopes in seven grand cascades of fire and mud, destroying a part of Torre del Greco, burning Resina to the ground, boiling multitudes of fish along the shore, and destroying many thousand people. So frequent have been these hot mud streams that they are often more dreaded than the currents of lava. You will notice that the flows of the eighteenth century have bursted not only from the southern side but from the eastern and western as well, here and there overlapping those of the previous century, but reaching the bay in only a single mouth. Among the more prominent of these is the eruption of 1794, at which time the glowing rock poured down the slopes with a solid front twelve to fifteen hundred feet wide, through the streets and alleys of

Torre del Greco, destroying four hundred lives and forcing its way more than three hundred and fifty feet into the sea. During the present century eruptions have been more numerous than at any other. Not only do they cover the Pedimentina, but from the crater they have flowed in every direction, but reaching the sea in two distinct channels a half mile apart. But the most remarkable stream for length is that which poured out of the atrium toward Naples, in a condition not greatly unlike fluid iron, reaching a point six miles from its source—the longest stream known in its history since the eruption of A. D. 79.

It is ten minutes past twelve while I sit upon one of the loftiest points of Monte Somma. The deep and desolate atrium is far below, while tremendous volumes of steam roll upward from a crater (seven hundred and fifty yards) nearly a half mile in diameter. No language can describe this sight, it is almost terrifying. At first I stepped behind some rocks, involuntarily breathing full and irregularly with an oppressive feeling I have never elsewhere experienced. The tiresome ascent of Somma having been completed, I expected to look across a narrow gulf upon a smoke stack, but through the driving clouds I saw a naked cone higher than the point upon which I stood, black as the darkness of midnight, and while exhibiting no signs of life it was all life. Expecting to witness but a mass of steam as from a caldron of boiling sap, I was filled with silent astonishment before the mountainous billows of fleecy vapors rolling slowly, majestically toward the skies, then swept sharply away by the driving winds. Somma, ascended for security, seemed but a toy above an energy capable of dashing it to atoms upon the surrounding plain. The precipice abounds with ragged projecting rocks of lava, fiery and variously colored, while its shelvings are filled with scoriæ and volcanic sand. For eighteen hundred years has Somma stood unchanged between the hot rain shot from the reddened throat of Vesuvius, while floods of liquid rock poured down through the atrium. Many dikes are visible while making the descent, their dimensions being from a few inches to twelve feet wide and from a few feet to five hundred in height, reminding one how inconceivable must be the forces that can thus split a mountain and fill the openings with melted rock.

Having made the dangerous descent into the great gulf which separates Somma from the cone, I thought of the Lachine Rapids of the St. Lawrence, just above Montreal. Were they instantly frozen, preserving their billowy surface, they would but poorly represent this dark, desolate and forbidding place. These now cold but once fiery floods remind one of shapeless masses of mud, with this difference, that the former are sharp, hard and extremely rough, while their masses, an inch to ten feet in height, are so intolerably ragged that one is in constant danger of spraining his ankles or cutting his hands by little falls. Were a thick dough of corn meal rapidly stirred, then quickly dried so hard that it would ring under the hammer, in some respects it would simulate a lava current. A striking feature of the current is, that while flowing upon a level surface, instead of spreading out like water, it erects its own boundary walls by the rapid cooling of its sides. It is said by observers of the living current that the slowest river of a plain moves faster than a lava current upon a considerable slope. Issuing from the volcano its tem-

perature is about 2000°, but, at a distance, the cake-like and curled masses indicate the molasses like character of the fluid. The scoriaceous and jagged surface abundantly testify to the slatic pressure of the fluid and the exhalation of its contained gases. One fails not to notice the few boulders of various dimensions, several inches to three feet in diameter, from brown to bright yellow, covered with a slaggy matrix, but broken open, presenting a pleasing and attractive relief upon the sombre, lifeless waste about them. Are these volcanic bombs, once torn from the strata beneath the mountain, shot from the great crater and shattered by the fall? Along the course of a current it would seem that its motion was frequently arrested for a moment, where it would heap, forming a bag or pocket ten feet in height, subsequently parting upon one or both sides, through which break the lava would pursue its destructive course. Continually is one stopping to examine these bag-like masses, botryoidal surfaces, tabular areas, curvilinear forms, and strange prominences, which occasionally assume some of the most fantastic outlines, and which would afford secure retreats for animals as large as the cat and dog. With great interest does one trace a single stream from the Atrium down the gentle slopes, through cultivated gardens, fruitful vineyards, orchards of olives and the golden fruit. Before you are many specimens of lava, collected both from Vesuvius and the giant Ætna. At the close of the evening you will have no difficulty in knowing those which were knocked from the surface of the current as they are rough and deeply cracked, while those specimens which came from the body of the current, not in contact with the air when in a melted state, are dense in structure while their rounded cavities will indicate the position of the cells which imprisoned the gases. This light, cylindrical specimen was evidently a bomb which came from the upper cone. Little or no pumice is found about Vesuvius, this piece and the most of our commercial article being obtained from Stromboli, whose fires have never for a moment been quenched since the earliest recorded history. An analysis of lava shows its general composition to be a silicate of alumina, combined with iron protoxide, potash, soda and lime. But the lavas of different centuries, if they do not differ in chemical composition, certainly vary in their physical properties. It is not a little striking, while walking over these lava fields to see a stream, cold, naked and forbidding as when it flowed a century ago, while another beside it, that flowed half a century later, is covered with a crumbled powdered surface, where atmospheric vapor and the rock moss have thoroughly prepared the way for the growing vine. In many specimens you will discover crystals of leucite, olivine and sodalite, but these perfect crystals of pyroxene I collected from Monte Rossi, an eruptive cone upon the southern flanks of Ætna. This single specimen of dolomite is found in considerable quantities about Monte Somma, but is wanting in the lavas of Vesuvius. If, as mineralogists tell us, obsidian is formed by a rapid cooling of lava, it is difficult to understand why none is found here, for the conditions of its formation would not seem to be wanting. This handsome specimen enclosed in its gray matrix, is owned in this city by Mr. Wilhite, who found it in Oregon of our own country. Many persons would call it a lump of dark glass. No single locality upon the earth's sur-

face has furnished so many simple minerals as the lavas of Vesuvius, and it can no longer be doubted that their manufacture in the great laboratory of nature is far from an extinct process. Here, Haüy, the founder of our system of crystallography, picked up no less than eighty simple minerals, but among these no native metals have ever been found.

From the uneven crater of this volcano destruction and death have poured for centuries. Different was the scene twenty-one and a half centuries ago, when the Roman fleet under Regulus, made its way to Carthage. Then the checkered vineyards extended far toward the summit, and the wild boar hid among the thickets of the crater. Now it is full of cloud-like steam of fleecy whiteness, which rolls to a great height when it is swept by a stiff breeze over the suffocated dead of its old victim—Pompeii. At no time is it possible to see across the great crater, so dense and continuous is the steam. Occasionally I saw its vertical walls, tinged with red, yellow and brown, and the shelvings of the rocks are heaped with black volcanic cinders. At Naples, eight miles away, the vapor seemed to rise but slowly; but here beside it, it rises majestically upward in great torrents, impelled by energies that do not sleep. Walking from the windward side around to the south margin whose width varies from twenty to seventy-five feet, I found the steam sulphurous and irrespirable, exciting violent coughing. The summit of the crater abounds with banks of nearly pure sulphur, rocks of variegated color, and volcanic cinders. Many portions of the surface are smoking, and not a few square rods are too hot for the soles of the boots. One delights to throw rocks into the crater from whence they came, and stepping away from the precipice, to dig into the noisy cinders where evidences of great heat soon become manifest. A guide, conducting an English party, placed some eggs in jets of escaping steam, which soon rendered them palatable. Thrusting a paper under a rock, it immediately took fire. Fifteen feet from the precipice, beneath a layer of cinders, I found the rocks incrusted with sulphur, sal-ammoniac and cubic crystals of sodium chloride, several times burning my fingers while throwing them into the air. Placing my green stick used for a cane, in a crevice, it cracked as in a stove, and in three minutes by the watch, I withdrew it all aflame.

One never tires seeing and toying with the great energies whose source is far beneath him, but whose origin lies in nebulous aggregation. One is impelled to think beyond his naked observations, and he fails not to ask: Whence this salt, which one tastes, upon the rocks? Immediately he descends far into the bosom of the earth, where he witnesses the scalding conflict between the rocks, half reddened by internal heat and the salt water that has poured through the creviced earth from the great Mediterranean above. A simple calculation from the quantity of steam continually poured from the crater, gives a result not easy to anticipate. A cloud, one half a mile diameter and two miles in length, condensed to saturation at 40°, represents about 20,000 cubic yards of water. Now, allowing that this vapor rises and floats away at the rate of four miles an hour, in a single day more than enough water would pass into the atmosphere to cover 104 acres to the depth of five and a half feet. Thus, in order to form a conception of one of the

probable causes of volcanic action, the imagination must enable us to realize this quantity of water making its way down through the crevices beneath the adjacent sea. Understanding this fact, the difficulty of perceiving the cause of the destruction of Herculaneum is greatly removed, when we think of the descending shower and the torrents of mud that must have succeeded it. If further evidence of the sinking of the Mediterranean waters were needed, it will be necessary only to state that fish have been found in the mud vulcanoes of the Caspian. Admitting this, the formation of hydroxides and hydrosilicates is no longer an enigma. This theory possesses a high degree of probability when we remember that the active volcanoes of the world are located near bodies of water. Thus are arranged the 28 active volcanoes of Java, the 109 between Australia and China, the thirty in Guatemala and S. A. Republics, the twenty (20) active volcanoes that separate the Atlantic from the North Polar Sea, the giants of the Sandwich group, Mount Erebus and Terror of the Antarctic continent, and in southern Europe, Santovin, Vesuvius, Volcano, Ætna, and, lastly, Stromboli, ever white with steam by day, and at night bright with his red glare. Equally striking is the correlative fact that, inland from these active volcanoes are extinct ones—instance those in eastern France, Northern Italy, in the Appenines east and southeast of Rome, and Mount Vultur, 80 miles east of Vesuvius. Throughout the 22,000 mile circle of fire which encloses the Pacific, all of its 225 active volcanoes as well as the remaining 75 in other parts of the world (Mayer) are not distant from the sea. Whether, as Lyell maintained, volcanoes rest upon a line of fracture, is a disputed question, but the synchronous, alternate and irregular phenomena of various volcanoes are hardly decisive.

While standing beside the Vesuvian current of flowing lava in 1819, Sir Humphrey Davy, of the Royal Institution of Great Britain, propounded a theory which, although subsequently rejected by him, exercised no small influence over the men of his time, it being advocated by Dr. Danberry of Oxford, in his great work on volcanoes. It was very simple, supposing only the existence of free alkaline metals in the earth to which air and water have ready access, resulting in heat and the ready flow of lava. Expressed in a concise manner, his explanation of volcanic action was the assumption of deep seated chemical action. As an illustration of his main thought—that of chemical action—I wish to perform an experiment or two. The possibility of chemical action being sufficient to produce volcanic phenomena must be admitted by every experimenter in physics, but the great improbability of free alkaline metals or their earths (?) existing in sufficient quantities at so great a depth or at all, is striking to the most superficial person. Perhaps the most plausible theory is that which is ascribed to volcanic action, to the existence of a fluid interior whose energies slowly radiate into space and whose shrinking nucleus is the source of earthquakes, explosions of liquid rock, and the elevation of mountain chains. While considering physical theories of any character, we must not forget that without acute, persistent, general and systematic observation, they are to that extent speculative and worthless. Not after observatories have been established upon the trembling sides of the volcanoes

themselves, and the areas of disturbance throughout the world have been provided with seismological instruments that will automatically record the time, direction and intensity of the subterranean forces, may we hope to lay a foundation substantial for future progress. Too many persons undertake the grandest and far-reaching generalizations, their cotemporaries freely accepting or rejecting them, without a competent knowledge of the elementary facts and principles upon which they must be based. Not only in the acquirement of science, but in the advancement of its state a personal knowledge of facts must precede that of its principles and the latter that of its laws, otherwise we may not approach nearer the truth than the ancient Romans who ascribed these phenomena to the struggling of giants overthrown by lightning from heaven, which outstretched them beneath the volcanoes whose eruptions attest the success and sincerity of their efforts for release. We may not, like the natives of Java, annually pour rice into the crater of the Sumbing to appease the God of Destruction, nor, as did the Neapolitans for centuries, march in solemn religious procession behind the elevated bust of St. Januarius toward the invisible devil, quite successfully threatening in the crater of Vesuvius, but unless scientific questions are attacked with method, and a confidence in the uniformity instead of the confusion of law, we shall make no greater progress than they.

Laying aside the deep seated causes there is no concord of opinion regarding the formation of the visible part of the volcano. Conceal the upper portion of Vesuvius, we then see a truncated cone whose base sweeps the sea and beautiful Campagna in a circuit of thirty miles. No one questions that the cone above the frustum was formed by showers of volcanic sand, cinders and lapilli, mingled with melted rock that rose from the crater—in other words, is an accumulation of matter from some point far beneath the earth's surface. A competent authority regards it highly probable that in the smoke, ashes and cinders of Vesuvius have been carried away over the sea ten times as much matter as covered the neighboring cities and deluged her flanks. No one doubts the truth of Dryden's conception

> "By turns a pitchy cloud she rolls on high,
> By turns hot embers from her entrails fly
> And flakes of mountain flames that lick the sky.
> Oft from her bowels massy rocks are thrown,
> And, shivered by the force, come piece-meal down."

But is it true, as Humboldt and Von Buch asserted, that volcanoes are formed by an upheaval of strata which are subsequently covered with lava, or, shall we believe with Saussure and Lyell that the frustum is formed as the upper cone is formed—by an accumulation of material? This question, like most others in life, must be decided not by an appeal to honored and reliable "authorities," but by a conscientious appeal to *facts*. The few observations made on this subject are decisive for the theory of accumulation. It is well known that the diameter of the crater and its height above the sea are continually changing, and it is probable that after it has many times blown the crater high into the air, it will finally fill the atrium to the very walls of Somma. We forget that the height of the vol

cano is very variable. The first barometric measurement of Vesuvius was made in 1794 by Abbe Nollet, who ascertained it to be three thousand three hundred and twenty-six feet in height. Twenty-four years later it was measured by Prof. Forbes who found that it had gained five hundred and sixty-eight feet, but in 1805 when Gay Lussac measured it, Vesuvius had lost thirty-eight feet from its last measurement. In 1822 it was measured again by that great scientific traveler, Humboldt, whose result was four thousand and twenty-two feet, and subsequently by Schiavoni in 1863, who determined that it had gained one hundred and forty-five feet since the time of his predecessor. The last measurement was made by Prof. Palmieri, of the University of Naples—the altitude being four thousand two hundred and fifty-seven feet. But these changes in altitude have likewise been accompanied by changes in the diameter of the crater which has oscillated to measurements greater and less than half a mile for a hundred years. Near the close of the last century its diameter was eleven hundred yards; in 1822, one thousand three hundred and twenty yards; in 1855, six hundred yards, and in 1861, seven hundred and fifty yards. These changes are constant, sometimes lowering its altitude, at other times rendering it more commanding, but enlargement is the tendency, and some time in the distant future it will have expanded so as to cover the Pedimentina, fill the great atrium, and at length assume the form and height of Vesuvius as it was in the days of heroic Spartacus and the epic times of Homer. To this future will succeed another in the Psychozoic, when to her beautiful shores there shall have been added other lands now beneath the adjacent sea; then will it be witnessed far inland, solitary as now, its stony and forbidding flanks decomposed to a rich soil, its smokeless cone washed with every storm, but its changeful physique, like its predecessor, Mt. Vultur, a long testimony to the energies that once filled it, a silent monument to the dense but forgotten populations that slept beneath the lavas or hovered about her base.

FOREST-TREE BORERS.

BY MARY E. MURTFELDT, KIRKWOOD, MO.

The insects that openly attack the staple crops of the field and orchard, are but few in kind, compared with the almost countless species that more indirectly but none the less surely militate against our enjoyment and our pecuniary interests.

Among the most important insects of the latter class are the forest-tree borers. The rapid decadence of our forests, so noticeable in many sections of the country, and the unreliability of indigenous shade trees around our dwellings, is in a large measure due to the insidious work of these insects.

Many of the most destructive species are of the utmost insignificance individually; but in the aggregate, become a formidable scourge, before whose attacks the stateliest monarchs of the forest fall into ruin, often within a single year.

The described species of American forest-tree borers number several hundreds; but the greater proportion of the injury is done by not more than twenty-

five or thirty species, all of which are included in the order *Coleoptera* (beetles). A few boring larvæ occur in the orders *Lepidoptera*, (butterflies and moths,) and *Hymenoptera* (four-winged flies); but, as a rule, the beetles enjoy a monopoly of this sort of work.

The wood-boring beetles belong to several widely different groups, and are classified according to their habits or structural peculiarities, as bark-borers, wood weevils, saw-horn borers, or *Buprestians*, and long-horn borers or *Capricornes*.

The bark-borers are all included in the family *Scolytidæ*, and are characterized by their hard texture, polished black, or dark colors, short, clubbed antennæ, and by their nearly cylindrical form which is truncated either squarely or obliquely behind. Few of the American species exceed one-fourth of an inch in length. Both sexes of these beetles bore into bark; the males in quest of food merely, and the females for the additional purpose of laying their eggs. The latter are placed on either side of a vertical burrow, cut partly in the inner bark, partly in the sap wood. The larvæ are fleshy, wrinkled, legless grubs, closely resembling curculio larvæ, and, like the latter, always rest in a curved position. They bore transverse diverging grooves, forming fanciful patterns on the inner bark, and corresponding ones on the sap wood. These burrows, which in the rear of the grubs are filled with powder and chips, cut off the circulation of the sap, and when, at all numerous, speedily cause the death of the tree. The grubs attain their growth during their first summer and remaining dormant over winter, change to pupæ in the spring. The beetles issue soon after, through small, round holes in the bark; badly infested trees presenting, after their emergence, "the appearance of having been peppered with No. 8 shot," as Prof. Riley remarks in reference to the Hickory Scolytus. The species belonging in the genera *Hylurgus* and *Tomicus*, are mainly injurious to pines and other evergreens; while those included in *Scolytus* attack, for the most part, hard-wooded, deciduous trees. *Scolytus 4-spinosus*, of Say, bores the hickory and pecan, and although a small species, is, on account of its exceeding prolificacy, one of the most destructive timber pests, and has been known, in many instances, to cause the death of entire groves of valuable trees within a single season. It works by preference in young trees and in the tops of the larger ones, where the bark is most penetrable. Nature has fortunately provided a check upon the increase of this insect, in the shape of two small parasitic flies, which penetrate to the grubs, through the holes made by the parent beetles, and lay their eggs upon the bodies of the former, which the fly larvæ, upon hatching, proceed to devour at their leisure.

The wood weevils include but few species of the Snout-beetles, (*Curculionidæ*,) as this family is mainly composed of species that inhabit fruits, nuts and grains. Those which live in wood are similar in their habits to the true Bark-borers, but are readily distinguished from them by the prolongation of the front of the head into a straight, or curved stout beak or snout, upon which are situated the elbowed and knobbed antennæ. They are chiefly injurious to trees of the pine family. The larvæ of some of the species bore the pith of the twigs and smaller branches, while others gnaw galleries under the bark, similar to those

formed by Scolytus, only not so fanciful in design. One species of *Magdalis* affects the willow and another inhabits the elm.

The Saw-horn Wood-borers or Buprestians include many of the most pernicious species. They are easily recognized by their flattened, oblong form, hard texture, metallic colors—generally brighter beneath than above—short legs and rather short, serrate antennæ. They are diurnal in their habits, and the trained observer often comes across them basking in the sun, during the middle of the day upon the trunks of the trees they infest. When disturbed, they instantly draw up the legs and drop to the ground, after the manner of the Snout-beetles. The eggs are laid in crevices of the bark, through which the larvæ penetrate to the sap-wood. Here they work during their earlier stages, but upon approaching maturity cut channels in all directions through the solid wood. The larvæ of the Buprestians are at once distinguished from all other wood-boring larvæ, by the excessively enlarged and depressed first-joint, into which the small head, with its dark, horny jaws, is partly retractile. The second and third thoracic joints diminish rapidly in size, and the hind body presents a comparatively attenuated appearance.

Our largest species, *Calcophora* (*Buprestis*) *virginiensis*, is about an inch in length, of a blackish color with coppery reflections. Its larva bores the trunks of the pine, causing considerably destruction in pine forests. *Dicerca divarica*, of Say, which infests the wild cherry as well as the peach, is about three-fourths of an inch in length, copper colored, with a granulated surface, the tapering wing covers terminating in two blunt projections. The larva of a much smaller and more inconspicuous species, *D. lurida*, bores the hickory. The most numerous and most generally destructive insect of this family, is the well-known "flat-headed borer," the larva of *Chrysobothris Femorala*, a brassy black species, about half an inch in length, familiar to all fruit growers as a dreaded orchard pest. This species not only attacks the apple, peach and other fruit trees, but is particularly destructive to oak, hickory, wild cherry and soft maple, annually causing the death of a considerable percentage of these trees, the timber of which is rendered useless for any other purpose than that of firewood, by the numerous channels cut through it in all directions by the grubs, All the Buprestians complete their growth and transformations within a year—the beetles appearing early in the summer, and laying their eggs for another generation of destroyers.

The last family of beetles to be considered in this connection, are the Long-horned or Capricorn beetles (*Ceramlycidae*). These are characterized by an elongate, rather slender, sub-cylindrical form, long legs and especially by the long, tapering antennae, which are curved forward or backward or waved gracefully through the air. Many of the species display beautiful colors and are adorned with stripes and spots dispersed in elegant patterns. When captured, or in any way excited, these beetles make a squeaking sound, by rapidly rubbing the first joint of the thorax against the second. Upwards of five hundred American species are described, although the larval habits of a considerable proportion of them have not yet been investigated.

The larvæ are prëeminently wood-borers; none of the species, so far as known, living externally on plants or feeding on anything else, besides ligneous tissue or pith. They are elongate-oblong, yellowish-white grubs, with small head and strong jaws, admirably fitted for drilling through solid substances. The incisions between the joints are deep and the diameter nearly uniform throughout, the thoracic joints being but slightly enlarged. The majority of these larvæ are provided with six pointed, scaly legs, one pair on each of the first three joints; while a few are entirely destitute of legs, or have the latter represented only by three pairs of tubercular points. Some of these species complete their development within a single year, while with others, two or three years elapse between the entrance of the larva into the tree and the emergence of the beetle.

The hickory is bored by a greater number of distinct species of Longicorn beetles, than any other of our forest trees. Conspicuous among these is the Banded Borer (*Cerasphorus Cinctus*). This species is over an inch in length, with very long curved antennæ. The color is a pale gray-brown, each wing cover being ornamented with an oblique, curving band of dull ochre-yellow. The larva, after entering, bores with the grain of the wood, occasionally cutting a channel transversely to the surface, for the ejection of its castings, and, finally, one for the exit of the beetle. Many pieces of timber designed for manufacturing purposes are spoiled by the unexpected advent of this beetle; and it not unfrequently damages manufactured articles, by cutting its way out of them, often at the very point where strength and solidity are most requisite. Another almost equally pernicious borer, is the Painted Clytus, (*Clytus Pictus*), a large, velvety-black species, elegantly ornamented with straight, curving, and v-shaped transverse stripes of sulphur-yellow. This species is undistinguishable in appearance from the common locust borer, (*Clytus Robiniæ*,) whose ravages have, within the last fifteen years, almost exterminated that once popular shade tree, the black locust. Another still larger and more gaily colored species of the same genus, (*Clytus Speciosus*,) is very destructive to the sugar maple; while a fourth (*Clytus Capreæ*) infests the trunk of the ash.

The walnut is bored by the Red-shouldered Apate, (*Apate Bassilaris*,) a handsome black species, having the bases of the wing covers red.

One of the species most common in oak is *Asemum Mœstum*, a small, dark brown insect, whose larvæ are said to require two years for their development. The Oak Pruner (*Elaphidion Parallelum*) is very destructive to the smaller branches, not only of the oak, but of a great variety of forest trees. The beetle is a slender, inconspicuous, grayish-brown species. The larvæ bore in the direction of the tree, and when mature, gnaw a transverse groove in the solid wood, leaving only the thin outer bark intact. They then retire backward an inch or more, filling up the space in front of them with their chips, The winds soon break off the nearly severed branches, and the ground in wood lots is often strewn with them, each of which, if cut open, early in the spring, will be found to contain either grub or pupa.

Another very singular insect of this family is the Twig Girdler (*Oncideres Cin-*

gulatus.) It deposits its eggs, singly, in the small branches of hickory, persimmon, crab apple and other trees, both wild and cultured; and after having done so, completely girdles the twig at a short distance below. This procedure is prompted by the instinct of the parent beetle to provide her progeny with dead but still fresh wood for their subsistence.

The elm, the beech, the prickly ash, the pine and other trees have their own particular borers among the Longicornes, as well as some which they share in common. But the enumeration and description of the various species would extend this paper beyond all reasonable limits. I will therefore conclude with a few words on the vitally interesting subject of remedies or preventives.

As far as the forests are concerned, man is utterly powerless against these lilliputian foes. He must leave all to nature, who, fortunately, take scare to prevent the extinction of one indigenous species, be it plant or animal, by another. Our forests are not, consequently, entirely abandoned to the unchecked ravages of the insects just enumerated. Undue multiplication is measurably prevented by parasitism. The parasitic species are mostly four-winged flies, belonging to the family *Ichneumonidæ.* These flies are endowed with a subtle perceptive faculty by which they are enabled to determine the exact location of the hidden borer, and by means of their long ovipositors they pierce to its retreat and consign their eggs to its body. From these eggs hatch maggot-like larvæ before whose voracity the grub soon falls a victim.

Besides the enemies of their own class a vast number of boring larvæ are annually destroyed by birds. We little know to what extent we are indebted to these feathered minstrels for comfort and æsthetic enjoyment we derive from trees. They not only destroy myriads of caterpillars and leaf-rollers that devour the foliage, but a large number prey habitually on the boring grubbs. Some of them like the little Nutchaches (*Sittidae*), Creepers (*Certheriidae*), and a few of the Warblers, particularly the little black and white Creeping Warbler (*Muiotilla varius*), are constantly running up and down the trunks and larger branches of trees, peering with their little bright eyes into every crack and under every scale of the bark in search of the insects that commonly lurk there. The Woodpecker also, especially the Red-headed Woodpecker (*Melanerpes erythrocephalus*), and the Flicker (*Colaptes auratus*), are valuable conservators of trees. They perceive and follow up the traces of a borer with undeviating accuracy, nor cease their drilling until it is disclosed. Even the much maligned Sapsucker (*Sphyrapicus varius*) probably does more good than harm. At least he is rarely found to attack perfectly sound trees.

Forest trees, standing separate around our dwellings, may be protected in great measure from the attack of borers by having the trunks occasionally rubbed over with common brown soap or washed with soft soapsuds. This substance seems to be distasteful to the beetles, and they will not lay their eggs on bark where it has been recently applied. If such trees are carefully watched the presence of a borer is readily detected by its sawdust-like cuttings, and it may be killed by probing the channel with a wire.

FOREIGN CORRESPONDENCE.

SCIENCE LETTER.

PARIS, April 13.

We are commencing to know something more reliable about infusoria in their relation with life and disease, and an immediate future reserves us some important discoveries. Ferments are petty organisms acting upon fermentable matter, and requiring oxygen for their development, since carbonic acid suspends their vitality. These animalcules, or vibrions, are peculiar to, and vary with certain diseases; thus the mange or scab is produced by the acarus, a kind of tick or mite, and so small, as their name indicates, as to affix themselves on other insects; they have been even found in the human eye and brain. The trichina is a vibrion peculiar to a malady affecting pigs, and anthrax or carbuncle is produced from animalcules called bacterides. By inoculating an animal with these bacterides or their germs, the malady is produced with a frightful rapidity. M. Pasteur, whose experiments on fermentation are so well known, lately deposited three hens on the table of the Academy of Science; one was dead, the others living. Ordinary animals when inoculated with a few drops of a liquid containing bacterides of carbuncle or *charbon*, die in a few days. But all the efforts of M. Pasteur were wholly unavailing to poison the blood of cocks and hens. Why? Birds have a higher temperature than other warm-blooded animals. Now the temperature of the body of animals that become affected by carbuncle, ranges from 95° to 102°, while the blood of domestic fowls is as high as 107° and 109°. M. Pasteur inoculated some hens with the carbuncle animalcules, but without result; next he reduced the temperature of the bird, by plunging it in water, then introduced the virus into its system, and after twenty-nine hours it died. Birds that were inoculated with the same virus, and at the same time, but retaining their natural temperature, escaped. A post mortem examination showed that the bird's blood was a mass of bacterides, and hence poisoned. At the same moment a third bird was also dipped in a cold bath—which did it no harm—to show that the proceeding could not have caused death. M. Pasteur has already demonstrated, that a temperature of 111° prevents the bacterides in course of reproduction from developing, and hence, in the case of birds, remain inert in their blood. He is now testing, if, after inoculating fowl at a low temperature, raising the latter will destroy the virus. Claude Bernard has demonstrated, mammiferous animals died when their temperature exceeded 113°. These experiments will have the most important bearing on the treatment of zymotic diseases which create such havoc in populous localities.

The Academy of Science has never been able to discern its Manni prize, for the best means of quickly and unmistakably recognizing, when a person is dead,

in order to prevent precipitate burial, of which the present Cardinal Archbishop of Bordeaux, among other instances, was all but the victim. Competition has narrowed the question but not solved it. In the present state of the inquiry, real death is recognized by the absence of heart beatings, as determined by auscultation, rigidity, insensibility of the muscles to electricity, and incipient decomposition. Excepting the latter, the other signs are not reliable. Of late the formation of a black or brown spot on the white of the eye, in shape round, oval or triangular, has been admitted as a test, and Drs. Garibaldi and de Lacharriere accept it as a "contributive proof" of death. This spot generally precedes by twelve hours the rigidity of the body. Decomposition often sets in very slowly, hence why in parts of Germany the dead are temporarily placed in a special house, coffins opened, and a bell rope near the hand of the occupant to summon the guardian in case of resuscitation.

No chemical question has been so much debated as that respecting the nature of the acid in the gastric juice; was it lactic or chlorhydric? M. Richet has determined that, in its fresh state, the gastric juice contains volactic acid; that this latter is only formed after a certain time, and appears to be a product of decomposition; this was peculiarly evident in studying the gastric juice of fish—the skate especially. Be the acid what it may, its presence is essential in order that the gastric juice can dissolve certain alimentary principles, the pepsine, or digestive element, losing its dissolving power in an alkaline medium, or one weakly acid, or neutral.

M. Faye has ventilated his theory on the formation of tempests. In all streams and rivers, one can perceive certain eddies, due to the difference in the rapidity of circulation of the tiny currents whose aggregate constitutes the mass of liquid. These whirlpools seem to move round a vertical axis, forming an inverted extinguisher. Swimmers know how dangerous are these eddies, which suck down all objects, and after transporting them to a certain distance throw them up to the surface. Similar phenomena occur in the air, where certain currents known to exist, are taken advantage of by aeronants. Now every current necessarily supposes a difference in the velocity of the fluid parts which compose it; their inequalities produce aerial eddies, known as tempests. The latter, following M. Faye, are simply whirlpools, with a vertical axis, describing curves almost as regular and geometrical as the stars in their orbits. Produced in the upper currents of atmosphere, tempests move in curves from the equator toward the poles, and in both atmospheres their march can be determined in advance. Originating near the equator, storms move toward the West, then incline Northward, and finally take an Eastern direction. Arago was the first to suggest the practical utility of these facts. M. Faye observes that were the Mauritius connected with the island of Reunion, by means of a cable, ships at anchor in the road of the latter could learn the certain approach of a storm from two to four days in advance. At the commencement of their circuit, tempests travel with comparative slowness—hence their coming can be heralded—increasing in rapidity

as they advance; they begin at the rate of a goods train often, and too frequently terminate like a "lightning express." M. Faye repeats that the Gulf stream exercises no influence on the march of storms.

The same gentleman denies that the planet Jupiter exercises any influence on the smallness or largeness of the sun's spots, because the duration and variations in size of the latter coincide with Jupiter's year, equal to nearly twelve of ours. M. Cornu is of opinion that the action of the sun, on the phenomena of terrestrial magnetism, may be due to the enormous masses of iron vapor contained in the external, gaseous strata, surrounding the sun. This might explain the diurnal variations of the magnetic needle, corresponding with the sun's positions, as geographical changes depend on differences of latitude. The same gentleman further thinks that iron forms an important part of all planetary bodies, bounding his conclusion on the fact that the mean density of our globe is a little more than double the mean density of the bodies which compose it; that its central mass is constituted of matters denser than the rocks on its surface—of metallic substances and most probably iron. The idea of Laplace was, that all planets were formed from a common cosmic matter.

Since 1859 there have been found mixed up with atmospheric dust, globules of magnetic iron, resembling those common spherical atomies of iron obtained on striking a common flint with steel, or that can be gathered in the interstices of paving stones over which horses have trotted. Messrs. Tissandier and Meunier have detected these microscopic spheres of iron in rain water and in air—dust gathered in the Alps. The minute particles of iron disseminated on the crust of meteoric stones present nearly an identical shape with those obtained by Tissandier. Are these particles of iron of terrestrial or extra-terrestrial origin wafted from forges by the winds? This peculiar iron-dust has been found in the Southern hemisphere by Admiral Serres in the depths of the ocean, profoundly imbedded in sand or mud. Nay, more, they have been discovered in geological strata anterior to the appearance of man on our planet; they have been detected in the earth excavated in the artesian wells of Paris, one-third of a mile below the surface. Now as these spherical atoms, gathered in divers latitudes and depths, are ever magnetic, Tissandier concludes, they are the result of iron dust, constantly dropping on the earth, and since time immemorial, from those extra-terrestrial sources—meteorolites.

M. de Baisbandran discovered two years ago the new metal *gallium*—which he found strangely enough before having seen it, by means of the spectrum analysis, in a piece of mineral; the metal by this analysis revealed rays not corresponding with those of any known metal. It is more valuable than gold, but as it melts in the hand, it is never likely to become a useful, though not the less remaining a precious metal. After enormous difficulty nearly four and a half tons of blende had to be fused, and the mass after further reductions treated by reagents to produce only two and a quarter ounces of *gallium!*

Although Boyle, from the year 1670, showed that air was necessary for the life of all animals, it was only at the commencement of the present century that Spallanzani demonstrated the identity of the process of respiration with all animals. Fish placed in free air absorbed oxygen and gave off carbonic acid; also when a stratum of oxygen was placed on the surface of water in which tench lived, the oxygen was absorbed and carbonic acid eliminated. But what ratio of oxygen disappeared thus in combination with fish? The latter take their supply o oxygen in a state of dissolution, while animals that live in the air absorb it in a state of gas. But here all identity ceases, for Messrs. Jolyyet and Regnard have just shown that aquatic animals never emit more of carbonic acid than they absorb of oxygen, and that with respect to the absorption and giving off of nitrogen, no result has been ascertained.

The average consumption of meat per individual in France per year is sixty-two pounds, and the price for the best morsels of beef is 2.50 fr. per pound. The engineers of the Paris and Rouen railway attest that when the navvies replaced their ordinary diet of bread, soups and vegetables with that of solid beef, the quantity of work they performed was increased three-fold. Vital statistics prove in the case of the cities of Lisle and Rouen, when the consumption of meat diminished, there was an increase in the death rate, and when the consumption augmented not only did the contrary result ensue, but a large addition was made to the births. The French do not care much for Liebig's extract or the Appert process of preparing meat; they want the latter natural and fresh. It is then with regret that the Tellier plan of preserving meat on board ship, by artificially prepared cold has failed, but more in a commercial than in a scientific sense.

Professor Bouchardat counsels those who eat pounded raw meat to be certain they purchase from a butcher who deals at the official *abattoir*, as much of the beef slaughtered in the provinces is diseased and is so delivered in Paris for sale, producing fatal consequences; in the handling of such meat in the market the porters have contracted malignant pustules. M. Mezrin draws attention to the breaking out in the artillery regiment to which he is attached, of the tape worm, in consequence of men eating measly bacon. May this not explain the prevalence of the same malady, which resembles a chronic epidemic, among the working classes of the city?

Dr. Legendre considers that scrofula and consumption are sisters, only different manifestations of the same causes. Velpeau was accustomed to say, "when you wish you can render a child scrofulous;" he meant by depriving it of the proper conditions of healthy life. Putting aside antecedents of parents, Dr. Legendre asserts that no treatment of scrofula can be effective, which has not for its base hygienic principles, and that these can be best practised by a residence at the sea-side; he further states from a long experience that the children of the poor are more speedily cured than those of the rich.

On the opening of the Exhibition the recently built Avenue del' Opera will

be lighted with electricity instead of gas, and colored dim globes will be employed to soften the effulgency. There is one draw back still to the new system, the necessity of having relays of machines to produce the currents. For a distance of one thousand yards three machines at least will be required to generate the fluid. Even this defect Jablochkoff expects to correct. M. d' Arsouval announces that he finds the telephone to be more sensitive than the nerve of a frog to electricity.

F. C.

HOME CORRESPONDENCE.

PLEASANT HILL, MO., April 27, 1878.

MR. T. S. CASE,

Dear Sir:—Please give the following a place in the pages of your next monthly:

April 18.—At 7:50 P. M. a meteor was observed to pass from near Theta Tauri toward a point beneath the Pleiades. Its trail was 5° to 10° in length, appearing only a second, then vanished.

April 20.—At 8:45 P. M. a meteor passed rapidly like a bright streak, 15° to 20° in length, Southeastwardly, between Taurus and Gemini, was visible two seconds. Clouds passing over immediately prevented its correct position being noticed.

April 24.—At 9:45 P. M. a meteor passed Northwardly between Bootes and Ursa Major with a path like a streak quickly drawn, and about 25° in length; apparently emanating from the Northern crown—visible two seconds.

April 26.—At 9 P. M. a meteor passed Southeast from the Northern crown. Train a quick streak about 10° long and visible a second.

You can also add to list of minerals found in Stony Meteorites, two in addition to those I named in my article in Number twelve of Volume one of your Journal. They are Lawrencite, named after Prof. J. Lawrence Smith, and Daubrielite, described in 1876 by Prof. J. Lawrence Smith and named after M. Daubrie, of France. The composition of the latter is: Sulphur, 37.62; Chrome, 62.38. These elements are proven by the spectroscope to be contained in the vapors surrounding the sun and therefore must be extensively diffused in the universe.

G. C. BROADHEAD.

The southern heavens presented a beautiful sight to those who chanced to be looking that way at half-past ten o'clock last night, May 4. A meteor was seen moving at a comparatively slow rate in a southeasterly direction, growing brighter, then dim again, then brightening, until it lighted the entire city. Large burning masses of the main body of the ærolite were thrown off, making the display interesting in the extreme. Persons who saw it pronounced it a phenomenon both strange and grand.—*K. C. Journal.*

MINERALOGY.

THE SILVER QUESTION GEOLOGICALLY CONSIDERED.

PROF. N. S. SHALER.

Many questions of a social nature can be fairly claimed by the geologist as coming within his domain, but of them all none are so bound up with his problems as those that concern the currency. * * * *

Before the geologist can answer the question as to the probable yield of gold and silver in future, he must make clear to the inquirer the general character of the laws that regulate the distribution of metals in the earth's crust, and their gathering into the lodes, veins, beds, and other places of deposit.

* * * *

The popular view of the origin of gold and silver deposits is that these substances are derived from the deeper stores of the heated interior of the earth, and that they have been sublimated thence and borne up into the overlying rocks; recent observations have materially modified this view. It is now believed that all the metals are contained in sea-water, and have been present in such waters ever since the oceans came down upon the lands. It is furthermore believed that these substances come into the sea-water by the same processes which bring common salt into the sea, namely, by the leaching of the land by the rain-water, which, armed with the carbonic acid gas given it by the decaying vegetable matter of the soil, is able to seize a part of almost all the substances it finds in the soil or in the rocks, through which it penetrates, and bear its waste away to the deep in the condition of complete solution, as sugar is dissolved in water. In this state gravitation has no hold upon the dissolved metals, and the particles of gold or silver washed away from the rocks of any district may be scattered by the ocean currents to the most remote waters of the globe. In the sea lives a vast variety of vegetable life; each of these species, after the law of its kind, takes from the sea-water a share of the various dissolved matters which it holds, just as the plants of the land take various substances from the decaying rocks that constitute the soil. Certain sea-weeds take up more of one substance, and others another; dying where they grow and succeeded by their kind, they gradually build a rock composed in the main of the substances which they have separated from the sea-water. Some weeds, as for instance the Sargassum, grow afloat in the water and sweep with the ocean stream into great eddies, such as the Sea of Sargasso, and then slowly rot and sink to the sea floor. Some animals, feeding on particular species of marine plants, take to themselves in this way peculiar substances, and when they possess particular parts of the sea floor they too help to build up rocks rich in certain substances.

In time these beds, laid down by particular animals and plants in the slow

events of life and death, become buried beneath thousands of feet of subsequent deposits. We then come to the last stage of the processes of making a mineral vein. The rocks becoming heated by means of the internal fires of the earth, the beds above serve as a blanket to confine the heat that is always escaping from the earth. These heated rocks are now traversed by hot waters, whose movement is, in part, impelled by the heat itself; these waters creep through the closest knit rocks, bringing about manifold changes in them. As they go downwards, the waters are continually taking more and more heat from the rocks; and each increase of heat makes it possible for the water to seize on more of the various substances contained in the rocks. When its course is turned upwards towards the surface of the earth, the water begins to cool; in its slow passage through the narrow avenues of the veins in the rocks, it begins to lay down the substances it has taken up in the lower parts of its course. Although heated water will take up a number of substances while it is at a given temperature, it will lay them down in a successive order as it cools, so that it tends to assort them as it leaves them in its course towards the surface. This brings the various materials into the grouped order in which we find them in veins and other deposits. With a brevity that leaves much that it would be desirable to say unsaid, this is an account of the way in which veins are now believed to be formed. It is easily seen that here, as in all other earthly successions, substances tread an eternal circle in the guidance of water and by the impulse of heat. Through water impelled by solar force the metal is worked out of the crumbling rocks and borne to the sea; by organic life, itself the creation of solar force, it is borne back to the rocks; thence, in time, it is to be taken once again upon its ceaseless journeys.

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The process of change that brings the dissolved silver of the sea-water into the deposits of the rocks, where we find it, is without doubt essentially the same as in the case of gold. There is, however, this peculiarity about silver: it is very frequently associated in considerable quantities with lead and with copper; in its association with the former metal it is often found deposited in districts where the evidence goes to show that the deposits have not required the intervention of highly-heated waters. The conditions favoring its occurrence in forms suitable for the miner's needs came about much more often in the workings of our earth's laboratories than in the case of gold. The result is that the area over which silver may be profitably sought is much greater than that over which gold may be searched for to advantage. In Europe, Norway, Saxony, Bohemia, Austria, Hungary, and Spain, have continued the production of silver for centuries with a steadiness not equaled in any other mining industries. In the Peruvian and Bolivian districts of South America the yield has had something of the paroxysmal character common to all gold districts, but this irregularity is apparently due as much to bad government as to any irregularity in the supply. Chili, where the government has been reasonably good, maintains a steadily increasing outpour of silver. There can be no doubt that in the future production of this metal the mines of the Andean district will be among the largest contributors.

Mexico and the extension of the Cordilleras to the north and within the United States partake in the abundance of silver which seems given to the Pacific coast of the Americas in a singularly great share. By far the larger part of the silver furnished to the markets of the world has been from this great mountain chain. In three centuries the Potosi mines alone yielded over twelve hundred millions of dollars' worth of silver; and in the same time the Mexican mines poured out about twice this quantity. The other mines in this Cordilleran chain have brought up the sum somewhere near five thousand millions of dollars. The American continents are, it would seem, proportionately more richly stored with the ores of silver than those of any other metal.

Besides the silver-bearing beds which are rich enough in silver to deserve the name of silver mines, there are many mines, which are mainly worked for other metals, that still furnish considerable amounts of silver; most lead-bearing ores yield a quantity of silver that pays for the additional labor required to win it from its combinations; the same may be said of copper ores. Although these sources of supply are but moderate, they are constant, and in so far act to secure that steady production of the metal which is of the first importance to its use as a standard of value.

The relatively ready oxidization of silver, its relative lightness, and its unfrequent occurrence in disseminated grains account for the important fact that it is never found in river deposits or other places where it can be readily won by the miner. Furthermore, only a small part of the deposits that can be drawn upon in case of need have yet contributed to the supply of the world. Silver mining in Asia, Africa, and Australia can hardly be said to exist. There are, doubtless, very many sources of supply yet untouched, as before noted. Most gold districts are first explored for gold which is scattered through their river sands; it is only at a later state of the prospecting that miners seek the lodes whence, by the wear of the surface, the scattered gold has been obtained. There are no such natural guides to silver deposits as there are to those of gold. It is only by rare accidents or careful prospecting that deposits of this description are found. It follows from these diverse conditions of occurrence of gold and silver that the former metal must be produced with far less steadiness than the latter.

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Silver gives a promise of steady yield in the future which is not afforded by gold. The sudden acceleration of production during the last few years, due in the main to the marvelous and unexampled extension of mining industry to the vast metalliferous region of the Cordilleras of North America, great though it has been, is not, considering the volume of silver, proportionately as disturbing in its effects as the inundations of gold from California, Nevada, and Australia have been. The Comstock lode is the accident of a century. Except for it the silver production of the Americas has had a singular steadiness during the last fifty years.

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There is no evident reason why within a few years the production of silver should not again fall to its average rate. Owing to the extensive demand for silver in Asia, its rapid wear and its great use in table furniture, a very few years

will fast drain away the existing surplus when the Nevada supply is withdrawn. Over a hundred years passed between the culmination of the silver production at Potosi and the period of greatest production in Mexico, and over fifty years between the time when the latter began rapidly to decline and the beginning of the prosperous days of the Nevada and Colorado silver mines. Each year makes it less and less probable that the world is to see new discoveries leading to such sudden movements of production. All the indications point to the steady yield of silver and to the unsteady yield of gold in the century to come.—*Atlantic Monthly.*

MISSOURI MINERAL PRODUCTION.

The Pig-Lead Association ascribes the greater firmness of the market to its combination. Its organization is not yet perfected and probably never will be, but it embraces our most prominent shippers. The "estimable gentlemen" composing the association claim to be better informed about the capacity of their mines, under existing circumstances, than those who are outside of the P. L. A. and not engaged in mining; they argue from the *Journal's* own reports from Utah that, unless lead advances, that State will not be able to continue its enormous shipments; that it will be time enough to consider the importance of similar shipments from Colorado when they come to market. In the meantime they aim to prevent a further decline by holding, and assisting others to hold, their lead. Fully aware of the probability that the production of lead in the United States may in the future far exceed the consumption, they still assert that at present the production does not exceed the demands of the country when in a healthy normal condition.

To meet the emergency, when it shall become necessary, the utmost efforts are now being made to establish the most rigid economy in the management of mines and the utilization of ores. Dressing works are largely introduced where ever veins or beds of sufficient extent warrant it. The total production of lead in Missouri is one-third below the late average. The new mines of Short Creek, Kan., diminish the deficit to one-fourth and may possibly cover the whole deficit by July or August next.

Short Creek has become the great attraction of the Southwest. Immense beds of mixed galena and blende in flint have been struck and are now profitably mined from twelve to fifty feet beneath the surface.

The countless clay diggings—that is, diggings in the red clay overlying the encrinal, second and third magnesian limestones of Missouri—find difficulty in making both ends meet, having hitherto only succeeded in making one end meet. The depreciation of lands of this nature is astonishing. One tract which sold a few years ago for $100,000 was recently disposed of for $16,000.

On the other hand, I notice with admiration the efforts of the proprietors of more permanent deposits to prepare for the coming struggle with the far west mines. The utmost efforts are being made to retain the reputation of Missouri

Lead, Tally No. 1. Short Creek, with its enormous deposits of lead and zinc at shallow depth, will easily hold its ground. Joplin, Webb, Oronogo, St. Joe and Desloges are ready for the war. Mine La Motte and Granby could, but for certain reasons will not. Necessity will teach them how to avoid the depreciation of valuable mining property.

The "Mining Items" of the *Journal* contained a notice of the Einstein silver mines near Fredericktown, Southeast Missouri. From Mr. Setz, assayer at Mine La Motte, I learn to-day that an average specimen, assayed by him, contained twenty-three ounces of silver. I vouch for the veracity of Mr. Setz.

The mining of zinc ore continues prosperous. The strong competition of Illinois, Kansas and Missouri smelters keeps the market very brisk for blende, which is preferred on account of its large percentage of metal. The erection of dressing works utilizing much of what has hitherto been considered unprofitable to dress, adds largely to the production.

The market for silicates and carbonates is very dull. The shipping of two-thirds of waste which accompanies these raw ores is an absurdity. Large profits can be realized by contracting for these ores and the building of furnaces at the coal mines in the vicinity of such deposits.

The iron mines and furnaces of Missouri are sleeping; only one furnace of the Missouri Iron Company, furnished with Iron Mountain ore, is in operation. South St. Louis, a few years ago the little Pittsburg of St. Louis, is as silent as a graveyard. Millions invested are locked up and moldering.

Most of our iron mines appear to be unable to compete, at the present state of the market and the limited demand, with other States where the proprietors have the advantages of coal and iron near together. It is claimed that the Iron Mountain Company could, if it would, thereby securing a partial revival of the great iron business of South St. Louis. Between that company and the Iron Mountain Railroad Company, lively letters have been exchanged in the St. Louis papers. As it is a subject of great importance, I shall try to obtain a clear insight into the matter, but how the Iron Mountain Company can possibly be induced to sell its iron for the benefit of St. Louis, if its own counsels do not tell it to do so voluntarily, is another question. The Iron Mountain Company is one of the wealthiest in the State, and its members are generally enterprising enough where they can see large profits. Millionaires, as a rule, are not expected to become patriotic until after death.

The white lead manufacturers of St. Louis protest against the charge of pig lead producers, that the white lead manufacturers had combined to depress the pig lead market. Mr. Thompson, the President of the White Lead Association, assured me that at the meetings of the association such movement had never heen thought of, as it would naturally have led to a depreciation of their large stocks of pig lead, which their business compels them to carry under all circumstances. Large purchases had been made by them when pig lead was quoted 5½ and 5 cents, and they certainly would not have done so if they had believed the price could be lowered still further.

Mr. Thompson has just returned from a trip to the chief white lead works of the country, and informs me that the proportional sale of white lead in 1877 has been 50 per cent. only of that of 1876.

The manufacturers of spelter complain about the same dullness of the market. Like the white lead manufacturers, their works, once started, are kept running like a runaway horse, with profit or no profit at the end of the race. One is hopeful, the other discouraged, the third wants to sell—but still they all keep running.

The only establishment for the manufacture of zinc oxide and barytes in St. Louis reports a large decrease of trade. Its ores are received from Southeast Missouri and Kentucky.—*Correspondence of the Engineering and Mining Journal.*

ARCHÆOLOGY.

NEW MOUND DISCOVERIES.

BY C. W. STEVENSON, STATE NORMAL SCHOOL, WARRENSBURG, MO.

Art is a temple, whose blazoned walls, written o'er with the histories of nations, give forth a steady gleam upon time, and upon whose shrine are placed the classic gifts of the Immortals. No better history of the acts, no better index to the character of a people can be found than that written so indelibly in their art productious. By art, the ideas and imaginings, the desires and caprices, as well as the accomplishments of a people are treasured up and fixed forever on the monument, the engraving, the painting and the statue. "The beings of the mind are *not* of clay—" they are "essentially immortal" and when they are imprinted upon adamantine rock, they are "immortal" to the world. Here do we find the finer feelings, the beauteous conceptions, cast, it may be, in the form of a mythical religion whose poetry only heightens their color, portrayed to us forever. And this is why we cherish every art production, as we would cherish the memories of the very hearts' desires, of those who have lived and struggled before, and by whose civilization we attain our present grandeur.

To the American it is especially interesting to study the art relics of that people, who, in centuries past, tilled the same lands and drank of the same mighty streams as he does to-day. The history of that people, upon whose civilization the same beneficent sun shone as it shines to-day upon his own enlightenment and comfort, must stir the finer feelings of his nature, while he must look with no little admiration upon the antique and beautiful ruins of Mexico and Peru. These ruins, crumbling with age and breathing forth the most delicate odors of fable and myth, found in a land, where may be seen in picturesque contrast the lurid flames of the volcano, the gleaming mountain capped with eternal snow, and the richly dyed blooms of the tropic, must remind him of the pictured land of Granada and the marbled halls of the Alhambra. Every relic of a peo-

ple once so enlightened, and possessing the refined feelings of to-day, must excite especial interest.

And while we are treasuring each relic of this departed race, with what feelings must we look at the Spaniards! No people in the world have destroyed the art-products of peoples with as ruthless hands as these Spaniards. Hardly had they conquered the Moors, turned their beautiful fountains, playing in music among groves of olive and pomegranate, into broken statues and stagnant pools, when they began to glut their greedy souls upon the riches of Anahuac, and, under the garb of religion to commit outrages and desolation unparalleled in history. The very scarcity of any traces of the people who once inhabited America increases an interest in finding those things which the imagination already pictures.

In the vicinity of Warrensburg, a few months ago were found remains, in the shape of tomb-mounds, of what we believe to be this famous people. The papers of the city teemed with sensational stories—fitted peculiarly to excite a morbid curiosity, and the consequence is that many mounds, rich, no doubt, in concealed history, have been worked with no system and only a few relics unearthed. These, however, as we shall show further on, are enough to establish the antiquity and civilization of the people.

Every mound excavated so far discloses the stone box within, forming the true cist. The walls of this box are made of flat stones, with no cement between, presenting an appearance very like the oldest form of cyclopean masonry in Greece. They are all essentially the same, their dimensions being nine feet in width, eleventh in length and six in depth.

We should state that these are the measurements of the box, the mound itself being about fifty feet in circumference at the base and ten in height. These mounds have been attributed to the work of the North American Indians by some, though this box within must entirely disprove such a statement. The Indians never buried in stone boxes erected for the purpose, and their defences wherever found, consist, in almost every case, of earth-works, stone being used very little. We cannot trace these mounds to the North American Indian and hence must give to them a greater antiquity.

If we divide the ancient history of America into two epochs, excluding the time when man co-existed with the animals, one commencing a few centuries before the advent of the Europeans, and extending to a time when the United States was settled along its whole eastern coast, the other embracing the time previous to this, we must place these mounds in this last named epoch giving to them a great antiquity and putting them beyond the pale of the most ancient Indian. For we know that the Indian was taken from the Stone age directly into the Iron and hence has no Bronze implements of his own construction. In the mounds found, are relics of the bronze age as we will see further on. We may name then the first epoch the mound epoch, and the last the historic epoch. From the many excavations in the different parts of the United States, it is determined that there are three classes of mounds, first, tomb mounds, second, sacrificial mounds, third, mounds for temples and palaces; the finding of bones in a state

of great decay, with some in perfect preservation, the former below, the latter above, and other attending circumstances, show that the original occupants of the mounds are very old, and that the Indians have also used the mounds as places of sepulture. Again, at the time the Europeans came into the country, the copper mines of Lake Superior were not known to the surrounding Indians, and hence we conclude, if the tradition of their being worked had faded from the minds of the conquering race, that the mines were worked by the most ancient of the mound builders, and in their mounds only will we find copper. In the mounds excavated in this vicinity, we find a piece of pottery having around it a copper band, establishing their very great antiquity.

Having established the antiquity and origin of these mounds, we need only mention other facts which tend to show that they do not belong to the Indians. The Indians were in every way inferior to the mound builders in art capabilities. In their burial places stone axes and hatchets are found; pipes, bowl and stem in separate pieces, made of red stone of the West, are peculiar to their burial places. Everything found in the mounds tends to show an advanced state of civilization and high art power.

Let us next consider some of the relics found in these mounds, and by comparison with the history of other excavations and also traditional history, find the character of this people and who they were. The least important of the relics are arrow heads found in all the mounds in abundance. These were taken by some as evidence of Indians, but erroneously, for it is known that the conquerors found them in use among the Aztecs, even the monarch Montezuma carrying a sword whose edge was of obsidian, and wielding a stone battle axe.

In one of the mounds a curious piece of mineral was found. It is covered with a reddish coating of oxide showing it to be red hematite and is so nearly pure iron as to lead one to believe the mound builders knew a rude method of smelting the ore. Another peculiarity of this small bit is, that from its shape one would say that it was a corner from a slab about ¾ of an inch thick. It is hardly probable that the people who buried in these mounds knew anything of the metal iron, for it requires an intense heat to smelt the ore, which must in all cases be obtained by mining.

A small piece of bone and a similar piece of flint, both circular, with the inside smooth, the outside polished and colored, were found, showing that a very delicate piece of work can be done without the use of bronze implements. These two specimens very likely formed the ruins of some vessel of so delicate a make up as to succumb to time.

Plates of mica have been unearthed, discolored with clay and so disconnected from all else as to leave their use only a matter of conjecture.

A very interesting specimen and one which bears largely upon the history of this people, is a large conch shell, nine inches in diameter, and eleven inches long. Whether the mound builders knew its use as a winding horn, or whether its fantastic shape and colors attracted their attention to it as a plaything or ornament, is immaterial, its presence in the mound establishes the fact of the migratory

character of the people. It must have come from the sea shore, probably from the eastern, as will be shown further on.

One of the important relics, is made of greenish-blue slate, and is what is known as a "skinning knife" or "scraper," the grooves running across it in various directions showing a rude attempt at ornamentation, while the hole drilled through it shows its means of attachment to the person. The "knife," as its name indicates, was used for skinning animals and for this purpose one of its edges is beveled or sharpened, the fine lines upon its surface showing contact with sandstone. Another use may have been in scraping the hides. What the ornamentation was to picture is mythical, though a decidedly strong imagination can form the imperfect outline of a head for either a bird or seal.

Another remarkable instrument found is a circular disc of a peculiarly fine grained stone with a groove around the edge, and a partial perforation at the center. It is 2¾ inches in diameter and one inch thick. The stone of which this implement is made is rather soft and contains much lime. We learn from accounts of excavations other than this we are attempting to describe, that in most cases these stones, used for drilling, resembling the jewelers tool of to-day, were hollow discs in which were inserted "bores" made of a species of cane growing in the southern part of the continent. How the hole in the disc was made for the reception of the "bore" is a mystery. The fine polish given to the disc indicates the laborious use of sand and water.

We next have a relic which is characteristic of the mound builders and establishes beyond a doubt that the remains found do not belong to the North American Indian. These "pipes" are often made of the very hardest stone and are found all over the Western States wherever mounds of this character are located. The stem and bowl are always in one piece, the bowl being often sculptured in the "mound-pipes," while the pipes of the Indian are plain, the bowl and stem being separate pieces.

The mound pipe found has a plain bowl, and is of the ordinary character of such pipes. The manufacture of these pipes must have been no small work, for we know that the people were ignorant, in the time of the present mound making, of the use of bronze implements, for none whatever are found. Perforations were often made in the stem, showing that the one found in the mounds under consideration was of an early date.

The only specimen of pottery recovered is a jar or urn, which will hold about three quarts, and is of rude construction, made of clay mixed with sand. Around the rim is a meagre attempt at ornamentation, while immediately below this is a band of thin, beaten copper. Below this around the bowl of the jar is a band of silver, also beaten very thin. The pottery of the mound builders shows simplicity and was made around baskets of wicker work or pumpkins. That of the North American Indian took on more fantastic shapes, and was very hideously and profusely ornamented.

The specimens described heretofore trace for us an almost complete history of the people who buried their dead in the mounds we have been excavating.

So far we have found no sculpturing in the mounds and no bronze implements. This tells us that the people were in the later part of the New Stone age. They were also in the beginning of the Bronze age, for we find that the use of the metals was partially known, as is indicated by the bands of copper and silver upon the jar. The art of glazing the pottery was not known, nor do we find it known at all among mound-builders wherever mounds have been excavated. The use of textile fabrics is indicated by the lines upon the jar, for this rude ornament must have come by direct imitation. The people were peaceful, for no weapons save arrow and spear heads have been found. No agricultural implements of note have been discovered, and the people must have been in the main nomadic in character, depending more upon animal than vegetable food.

But who were these people?

We say these people formed the ancestors of the civilized Aztecs and are either the Chichimecs or Toltecs. "Time which antiquates antiquities and hath an art to make dust of all things," has left a chain of tradition, that, linked with the circumstantial evidences of these mounds points in fixed colors the history of that people who buried their dead over Missouri and her adjoining states.

From Spanish history connected with the conquest, we learn that a people, well instructed in agriculture and many of the useful mechanical arts, and nice workers in the metals, came into Anahuac, the territory of Mexico of to-day, before the close of the seventh century. They came from the North and after about four centuries passed away, giving place to another tribe from the North. These two peoples are respectively the Toltecs and Chichimecs. The migration of the Chichimecs was speedily followed by others from the North, the Aztecs being the last and most important tribe.

The Aztecs after many wanderings, overcoming in the mean time the Toltecs and imbibing all their civilization, noticed, according to this myth of their history, near Lake Mexico in the year 1325, a royal eagle perched upon a prickly pear, a serpent in his talons, and his broad wings opened to the rising sun. The beautiful picture thus presented to their darkened minds was hailed as an auspicious omen, and upon the spot where was seen the king of birds, was laid the site of the future city. From this time art and letters were cultivated and there is enacted that miraculous story of grandeur and civilization equaled only in the legends of romance and mythology.

From direct examination of the works of the mound-builders the oldest and most primitive forms are found in the extreme South of the continent, a fact in direct opposition, it seems, to the tradition existing in the time of the conquerors that the inhabitants of Mexico came from the North.

The theory in regard to the direction of motion of the invaders of Anahuac or Mexico is, and all the excavations tend to substantiate it, that the people who anciently inhabited Mexico *did* come from the South, passing through Mexico into the Valley of the Mississippi. Wandering over this fertile field, then much warmer than now, they penetrated the more northern parts, discovering the Great Lakes and the well-known copper mines of this region. Here they remained for

a time, and were either driven again into the valley by the cold storms of the climate or some invading and stronger people. Thus successive swarms of peaceful people recrossed the Great Monarch and his well watered valleys, finding a final resting place in the fastness of Mexico. The last tribe to leave the mines in the Northeast were tribes afterward known as the Aztecs, who carried with them the highest degree of civilization then reached, shown most clearly by bronze implements. The Aztecs were probably driven from their northern homes by the North American Indian.

In the mounds which we have been describing, we have found no bronze implements, but have found metals beaten into thin plates, as silver and copper, hence we conclude that, as the Toltecs knew the partial use of the metals, but were not in the bronze age wholly, it must have been this people who made the mounds in question upon their return journey to Mexico. This would give to the mounds, according to the tradition heretofore stated, an age of about ten centuries. We cannot presume too much, however, upon the superior knowledge of the Aztec tribes on leaving the Lake Superior regions; all theirs may have been built up after reaching Mexico, though this is hardly probable. In case these mounds *were* made by the Aztecs, their age would be reduced to about six centuries.

This people, then, be they Toltecs or Aztecs, who erected these mounds for their dead, and who possessed the primitive culture shown by these few relics, passed on from these fertile valleys of the Mississippi into the tropical climes of Anahuac, there to enact a storied history made known to the world by the genius of the immortal Prescott. Romance nor fable presents so varied and so brilliant a picture.

Upon their arrival in this land of enchantment, a mighty god Quetzalcoatld, came across the waters in a "Wizard ship made of serpent skins," and taught them agriculture and the further use of the metals, as well as the art of government. The whole land was turned into a beauteous Eden, teeming with delightful grass carpeted groves and the most delicious fruits, while nature adorned herself in varied and fantastic colors.

Here in this Elysium they developed their incongruous religion, associating with pure ideas of the true God the dark rites of human sacrifice. Here, in the blind superstition and fanaticism of their natures they tore the palpitating heart of the victim from his body and in mad frenzy cast it at the feet of their God, afterward spreading the flesh of the human and brother in a feast, teeming with delicious beverages, before his friends, and where this same inhuman sacrifice was performed might be seen the peaceful, pleasant picture of children wreathing the statues of the gods with flowers and feeding the sacred fires. Here mighty temples and palaces arose, covered with the most delicate gold and silver casings, reflecting in all their glory the rays of the awful Sun-god; here poetry, eloquence and the fine arts flourished, lifted their proud forms in grace and beauty when the icy demon-like hand of the Spaniard by one blow effaced people and works forever.

ARCHÆOLOGY IN CENTRAL AMERICA.

A very interesting consignment of pottery, images and implements recently recovered from the ancient graveyards in Chiriqui, Isthmus of Panama, was received in New York city a few days ago. Several gentlemen, representing the Smithsonian Institute, Washington city, also the Metropolitan Museum of Art, pronounce the collection altogether unique and the finest of its kind extant. All authorities agree that they are the remains of a pre-historic race, but nothing positive can be affirmed as to their exact age. The graveyards from which they are taken cover an extensive range of coast some 300 miles northwesterly from Panama, as described in the correspondence below, some of them covered by an apparently primeval growth of forests, and now for the first time a systematic exploration of the region referred to has been commenced in the interest of science. For years past considerable quantities of gold have been taken from them, in the shape of ornaments, idols, &c., closely resembling objects of a similar character found in Peru, and which are supposed to date from the time of Incas, or a period remoter still. More than ten years ago, Mr. J. M. Merrit, now of Flushing, stated before a meeting of the Ethnological Society that he once had a golden tiger from Chiriqui which weighed fifteen ounces. Dr. E. H. Davis exhibited drawings of a golden toad from the Chiriqui graves which weighed seventeen ounces. In Messrs. Lamson's collection, tigers, toads and nondescript creatures of various sorts, are seen in the form of burnt clay, gaily ornamented with pigments. Articles in sheet gold are occasionally found both in Chiriqui and Peru. A golden shroud found in Arica, Peru, some years ago, weighed eight or nine pounds.

"I had expected ere this to have come to a more definite conclusion as to the age, &c., of a people, the works of whose hands alone remain to tell us that a race, vastly superior in many respects to that found by their Spanish conquerors a few centuries ago, once thickly populated this land, and at so remote a time as to leave a very few traces of organic remains.

The vast area over which these burial grounds are spread, and in many cases so closely occupied, affords evidence that the more elaborately constructed graves or vaults have been used as family sepulchres.

The most definite proof of antiquity I have seen is the numerous stone cutting implements so generally found, with other works of human fabrication, in these graves. Some of these may have been used in sculpturing the highly wrought images found with them.

It is observed that in all the graves which have been worked of late years, mainly for gold, those nearer the center of the group are richer in gold and the character of the implements is superior compared with graves more remote. These burial places are found alike in what appear to be primitive forests, on the highest mountains and open plains. So far as I have seen, and from information gathered, this vast cemetery extends over hundreds of square miles on this coast. Though there are seldom any surface indications to attract the attention of the inexperienced eye, the expert grave diggers, who have been long in the business, are

not long in showing the traveler a *wauca* by any roadside. To ascertain the position a light iron bar is run into the ground from one to four feet. On striking a stone the expert recognizes a peculiar sound, clears the ground and begins the excavation. It often happens that ten or fifteen feet of earth must be removed before the vault is reached. This is covered with large, flat stones, some of them weighing 300 pounds, and of a different character from any found nearer than several days' journey far up the mountain's side. The sides of the vault are formed of large boulders, evidently brought from rivers' beds far distant. Fragments of implements distributed through the top earth affords evidence that the graves have been repeatedly opened for later interments.

In all the groups of graves I have examined the interments were made promiscuously, at much cost of space. Many of the graves most carefully constructed are observed to contain scarcely an implement, while alongside there might be a long, narrow receptacle containing numerous pieces. Among the implements I now send are several curious stools or seats, which the modern inhabitants believe were worn as crowns, under the supposition that they were bestowed by the gods. You will ovserve that very generally the earthen vessels are made with light handles or projections, so that they might be suspended, while other have legs. It is my belief that all the canteras (local name for all these objects), once contained articles of food, as no implements are ever found within them. You will observe that there is every variety of style, varying from the unique to the ridiculous. The gold, in particular, has been wrought into many droll forms, much of it exhibiting no mean artistic skill. This beautiful handiwork of a long forgotten race contrasts strangely with the rude fabrications of those who now inhabit the land."

ASTRONOMY.

THE TRANSIT OF MERCURY.

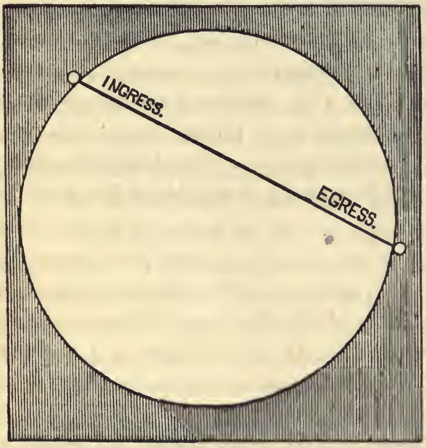
Transits are only possible to us by Venus and Mercury, as among planets discovered these are the only ones with their orbits inside that of the earth. The transits of Venus are very rare. That of 1874 will be succeeded by another in 1882, and this will be the last for more than a hundred years. Those of Mercury are much more frequent, occurring at intervals of 13, 7, 10, 3, 10 and 3 years.

Mercury travels in a very eccentric orbit, his mean distance from the sun being about 35,392,000 miles—his greatest distance is 42,669,000 miles, and his least 28,115,000. When nearest the earth we are within 45,000,000 miles of Mercury, and he goes as far away from us as 135,500,000 miles. From his nearness to the sun Mercury is rarely visible to the naked eye—sometimes immediately after sunset and again shortly before sunrise—the most favorable time for observation being when he is at his greatest elongation, which then places him at at about 85,000,000 miles from us.

The size of Mercury is about 3,000 miles diameter. His mass is denser than that of the Earth, being compared to it as about 10 to 9. He travels round the sun in a little less than three of our months, and his day is about as long as ours.

A transit of Mercury is not so important as that of Venus, because his nearness to the Sun prevents his having a measurable relative parallax. The distance of Venus from the Sun is such that when in transit, seen at the same moment from different points of the Earth's surface, she occupies two spots visibly separated from each other, thus allowing the angle to be measured, by which the Sun's distance from the Earth can be calculated. But Mercury being so close, this is impossible. But these transits are valuable as illustrating the same phenomena which occur in transits of Venus—the black drop, a small black ligament, which at the moment of contact seems to connect the disk of the planet with the dark space outside the solar disk. This in transits of Mercury is very manifest. Other indications observable clearly point to the existence of an atmosphere of considerable depth and density.

The diagram below shows the points of ingress and egress, and is represented as if seen by the naked eye. Seen through a telescope, which reverses the position of an object, of course it would present a different view from this, but as the readers of the Journal will, as a rule, look at it through ordinary glasses, we give the illustration to suit them, as an astronomer who has a telescope needs no information on the subject. To catch a view at the very earliest moment of contact, the eye must be directed to the exact point on the limb of the sun, and everything should be ready at 9 o'clock city time at Kansas City. We are very favorably situated for a view of the entire transit, should the day be clear, as it occupies 7½ hours in passing across the sun.

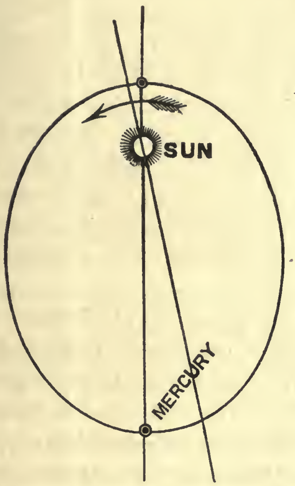


But the special value of this transit to astronomers is the light it may throw on the hypothesis of the existence of a planet with an orbit interior to that of Mercury, predicted by Le Verrier from calculations of the perturbations of Mercury. This great astronomer discovered Neptune in this way, and he died with the full conviction that a planet he had named Vulcan exists between Mercury and the sun. Lescarbault, and Wolf, and Weber, three observers in Europe, claim to have seen such a planet, and so does our weather prophet, Tice, who makes it a very important factor in his forecasts.

Le Verrier discovered perturbations in Mercury, which no known cause could explain, and placing all recorded observations of transits along side his computations, he estimated that the point of Mercury's perihelion moved more rapidly than it should move from the influence of known bodies. The variation

is about thirty-six seconds of an arc in a hundred years, or near one thirtieth part of the angular diameter of the planet in a year. But slight as this is, it is a departure from the law which governs, or seems to govern, the orbits of all the planets.

This diagram shows the exceedingly eccentric orbit of Mercury. The line passing through the sun, from perihelion or nearest point to the sun, to aphelion,



or farthest point from the sun, is what is called in astronomy the line of apsides. It is always moving on the sun as a centre from right to left,—the same direction the planet itself is moving,—according to a certain constant of motion. Or the orbit of the planet turns round the sun as does the planet itself, only in a vastly greater period of time—in degree as a cam-wheel turns on its axis placed out of centre. It was the undue velocity of this great cam-wheel of astronomy, which disturbing the movements of the planet and its times of transit, arrested the attention of the great French astronomer and led him to ascribe it to the influence of an unknown and interior planet.

It will be remembered that a year ago, at the instance of Le Verrier, the whole astronomic world was on the *qui vive*, looking for the new planet, but failed to discover anything. In the meantime Le Verrier died, but his theory remains. There are two parties among astronomers on this question—those who favor the theory of the existence of Vulcan, and those who think the calculations of Le Verrier contain an error—or that he was mistaken in his assertion as to the acceleration of the apsides of Mercury. Among the latter is no less eminent an authority than Dr. Peters, who suggests that in making up the difference between computation and observation, Le Verrier had erred in overrating the observations themselves, especially the older ones, as for example, the transits of a hundred years ago. So has M. Liais, of the Brazilian coast survey—both declaring against any variation which required the existence of an interior planet.

It is this disagreement which gives astronomical importance to the transit of Mercury which takes place to-morrow, and it is to be hoped the observers in Missouri and Kansas will be able from our clear skies and favorable conditions to add something to the solution of this very interesting question.

The exact time of ingress is 10.04, Washington time—of egress 5.34, same time. Our readers, by remembering that the earth is 25,000 miles in circumference, and the time a fraction over a thousand miles per hour difference, can make their estimate for their localities close enough for all but strictly astronomical observations, and where these are made they do not depend on newspapers for one. At Kansas City the transit begins, to be exact, at 8 o'clock, 53 minutes and 12 seconds, and ends 4.23.42. The difference in time between Washington and Kansas City is 1 hour, 10 minutes and 18 seconds—fast.—*K. C. Journal of Commerce.*

VARIOUS OBSERVATIONS OF THE TRANSIT.

Those at St. Louis were made by Mr. Pulsifer and Prof. Rees, of Washington University, at the observatory, just back of the residence of the former gentleman, at 1837 Kennett place. Of course, in order to get the observation within the nearest possible second, it was necessary to get the exact position of the point of observation, as well as the exact time at which the observation was made. The exact time was obtained from Washington by the Western Union Telegraph, but time will be taken each day from the 1st to the 10th of May, in order to more accurately compute the time by the chronometer used at the observing station. The more accurately the running of the local chronometer is known, the more valuable, all other things being equal, the result of the observation made by their aid. Hence comparisons of time will be made twice daily, until the 10th, when they will cease. Then, again, as the time signals from Washington are received at the Western Union office down town, and the observing station was at Mr. Pulsifer's, over a mile west of the time-receiving point, it was necessary to know exactly the difference of time between the point down town and the observatory. People very seldom think of this fact, and we often see two clocks, one some miles west of the other, indicating the same time, while the actual discrepancy should be four seconds for every mile of western distance. The difference in time between Washington, at the Naval Observatory, and the Court House dome at St. Louis is 52 m. 33.27 sec. west, or earlier, and the difference in time between the Court House dome and our Washington University is 3.63 seconds, or between Washington City Naval Observatory and our own observatory at Washington University 52 m. 36.9 sec. It remained then to get the exact point of observation to compute the latitude and longitude of Mr. Pulsifer's house, the latitude and longitude of the Court House being known. The observers, therefore, went to the Board of Public Improvements and had a line measured from the Washington University Observatory, perpendicular, to Washington avenue, and a line drawn from the corner of Mississippi avenue and Kennett Place, perpendicular, to the last line. By measuring these lines and knowing the course of the streets, it was calculated that the latitude of Mr. Pulsifer's Observatory was 38° 36 m. 52.8 sec. of arc. Similarly the operators calculated that the observatory on Kennett was west in longitude 2 sec. of time from the University building, which would give it about 6 sec. of time west of the Court House, or an actual longitude of 13° 13 m. 43.5 sec. west of the Washington City meridian.

Accurate time was carried to the Observatory by means of two fine pocket Jurgensen chronometers from the University chronometer and Jaccard's, both of which were compared with Washington City time. The watches finally used in the observation were compared twice on the day of observation, and will be compared daily till the 10th with the Bliss chronometer.

On account of cloudiness at the time, the first contacts were entirely lost, but about four minutes after the time of first contact the clouds broke and the observer was able to see Mercury projected on the sun's disc in very beautiful style. The two last contacts, however, Mr. Pulsifer was able to see very nicely indeed, and

the times of second internal contact and of separation were carefully observed. The time of last internal contact was 4 h. 41 m. 21.25 sec. p. m., and the time of last internal contact or separation was 4 h. 44 m. 17 sec. p. m., giving 2 m. 55.75 sec. as the time occupied by the body of Mercury in passing over the circumference line of the solar disc.

It may here be stated that these figures as to time have to undergo still further comparison and calculation before the full report of the observation will be made to Prof. Newcomb, at the Washington Naval Observatory. It was of course a great disappointment to the St. Louis observers that after days and nights of preparation they should have missed the first two contacts, but the misfortune was unavoidable and could not have been helped.

At Washington University, Prof. C. M. Woodward rigged up the eight-inch Fitz telescope, belonging to the University, at one of the south windows, and was enabled to show to most of the students and teachers of that institution the dark body of the planet traversing the sun's disc in excellent style indeed.

At various points throughout the city smoked glass and field glasses were brought into play, but afforded no result other than the mere sight of a black speck on the sun's face.

According to observations of Prof. Newcomb and assistants, at Washington, the second internal contact of Mercury with the western edge of the sun occurred at 33 minutes 50 seconds past 5 o'clock this afternoon, and the external contact 2 minutes and 50 seconds later. The planet, through a telescope, appeared not larger than a silver 50-cent piece. The gentlemen engaged in the work say there could not have been a better day for observations. Prof. Eastman was at the old telescope at the National Observatory, and Prof. Hall superintended the taking of photographs of passing planets. These photographs were produced by means of horizontal telescope and reflector.

Observations were taken from the United States Observatory at Ogden, Utah, of the transit of Mercury by Prof. Andre and party, French astronomers. The transit commenced at 7:44 a. m., but the sun was obscured by a cloud. The sky cleared about noon. Only three photographs were taken up to 1 p. m., after which time seventy-five photographs were taken to the time of exit, which was at 3:17 p. m. The observations are regarded as satisfactory and successful.

Observations of the transit of Mercury, at Cambridge Observatory, were somewhat interfered with by clouds, but in the afternoon a clear sky afforded a most favorable opportunity for observation. Contact took place several seconds later than 10:26 a. m. The general results are considered quite satisfactory.

Prof. Peters, of Hamilton College, Clinton, made successful observations of the transit of Mercury. Clouds interfered somewhat with the observation of internal contact. Prof. Peters is of opinion he discovered indications of atmosphere on the planet.

Observations for all four contacts of Mercury with the sun were successfully made at the West Point Observatory.

MEDICINE AND HYGIENE.

PARACELSUS.*

BY DR. H. CARRINGTON BOLTON, OF TRINITY COLLEGE, HARTFORD, CONN.

In the sixteenth century the passion for alchemic labors attained its greatest height; it penetrated all classes of society from the peasant to the King. The humble tradesmen, the well fed and indolent monks, the learned physicians, the overworked and poorly paid soldiers, the unscrupulous and avaricious Princes, Electors and Kings were seized with the fever for sudden riches to be gained by the hermetic art. A belief in the transmutation of metals, the Elixir of Life and the Philosopher's Stone was well nigh universal. Among the number of those who pretended to possess the philosopher's stone and the universal panacea, none were more boastful and vainglorious than the physician Paracelsus.

This extraordinary man was born in 1483, near Zurich, Switzerland. His father was a cultivated physician and by him Paracelsus was instructed in astrology, alchemy and medicine. He also studied with eminent tutors one of whom was a priestly alchemist and reputed adept.

While still young Paracelsus served as a surgeon during the war against the Venetians and against the Dutch. He afterwards set out to travel for the purpose of acquiring information from the medical men of various countries, in accordance with the custom of the time. He also paid special attention to mining, and traveled as far as Russia in search of mines. While on the frontiers of Tartary he was taken prisoner and carried before the sovereign prince of that country. He was subsequently released, but took advantage of his captivity to learn many secrets of his profession. While in the East he visited Constantinople, at that time the headquarters of alchemists, and there learned the secret of the philosophers' stone. Finally he returned to Germany, and having effected some remarkable cures rapidly acquired a great reputation, to increase which he boastfully announced himself capable of curing all diseases by means of the Elixir of Life. Having attained great eminence he was made professor of surgery and medicine at the university of Basle. Here he was a colleague of the famous theologian Erasmus.

Paracelsus' public lectures delivered in German instead of the customary Latin, drew a great crowd of hearers. Some of his lectures are extant and resemble a collection of advertisements of quack medicines. At his opening lecture he caused a fire to be brought in a brazen vessel and casting in sulphur and saltpeter he solemnly burned the writings of Galen and of Avicenna, whose practice then prevailed.

"Know, physicians," he said, "my cap has more learning in it than all your heads; my beard has more experience than whole academies of you; Greeks, Latins, French, Italians, I will be your king."

His opinions of the Galenical physicians were expressed in coarse language, while his praises of those who employed chemical medicines were hardly less

*Extract from a lecture delivered before the Long Island Historical Society, Brooklyn, N. Y., April 23.

notable. "But now seeing idleness is so much in request amongst (Galenical) Physitians, and all labor and study is turned only to insolency, truly I do not wonder that all such preparations are everywhere neglected, and coales sold at so low a price that if Smiths could be so easily without coales in forging and working their Metals as Physitians are in preparing their Medicines, certainly colliers would long since have been brought to extreme want. In the mean time I will give to Spagiricall Physitians (chemical physicians) their due praise. For they are not given to idleness and sloth, nor goe in a proud habit, or plush and velvet garments, often showing their rings upon their fingers, or wearing swords with silver hilts by their sides, or fine and gay gloves upon their hands, but diligently follow their labours, sweating whole nights and dayes by their furnaces.

These doe not spend their time abroad for recreation, but take delight in their laboratory. They wear Leather garments with a pouch and Apron wherewith they wipe their hands. They put their fingers amongs coales, into clay and dung, not into gold rings. They are sooty and black, like Smiths and Colliers, and do not pride themselves with cleane and beautiful faces. They are not talkative when they come to the sick, neither doe they extoll their medicines: seeing they well knew that the Artificer must not commend his work, but the work the Artificer, and that the sick cannot bee cured with fine words."

(From Paracelsus, "*Of the Nature of Things*" printed in London in 1650, 4to.)

Paracelsus used to claim knowledge of medicines derived direct from God, and once said: "If God does not aid me the devil will help me." His fanatical self-conceit is exemplified in a remark comparing himself with the great reformer, Luther: "Luther is not worthy of untying the strings of my shoes!"

These are but glimpses of his vainglorious, arrogant and bombastic character, in spite of which his lectures were for a time very successful. After a few years, however, his hearers grew weary of his audacious assumptions and disgusted with the low life he led, for habits of intoxication increased and he became a wretched drunkard.

Resigning his professorship he began traveling again and joined by a number of boon companions he passed his time in drinking and carousing. After four years of dissipation, to use the quaint words of Boerhaave "he died as he lived, in a tavern, at Saltzburg, at the sign of the White Horse, on a bench in the chimney corner." This was in 1541, in the 47th year of his age.

In his life time, Paracelsus published only a few books, but after his death a large number were printed in his name. His genuine writings are infected with the arrogant pretensions characteristic of his life.

And yet this "great, anomalous, unaccountable fellow" as "Boerhaave calls him deserves much honor for having introduced chemical preparations into materia medica, making a knowledge of chemistry indispensable to all physicians. He mentions zinc and bismuth as metals, he was acquainted with the virtues of opium, and introduced mercury in specific diseases. He seems to have been a skillful surgeon and to have excelled in the preparation of drugs, a labor which occupied, as a contemporary tells us, "all his sober hours."

EDISON AND THE PHONOGRAPH.

We compile from the *Phrenological Journal*, to which we are also indebted for the excellent accompanying portrait, the following account of Edison and his wonderful inventions.

Thomas Alva Edison was born in Milan, Erie County, Ohio, on the 11th of February, 1847, and is, therefore, scarcely thirty-one years of age. He was a newsboy at eight; and, at the age of twelve, obtained an exclusive contract for the sale of newspapers on the Detroit division of the Grand Trunk Railway. Here his energy and determination to excel began to exhibit itself. He employed several boys to aid him, and continued to travel and sell newspapers until seventeen years of age. Meanwhile, he purchased a small printing outfit, which he carried on the train, and with which he printed a small weekly paper, called the *Grand Trunk Herald.* In this office he was editor, manager, typo, devil, and all, within himself.

Edison soon became absorbed with the telegraph, and speedily very proficient as an operator. He took charge of the telegraph office at Port Huron, but soon quitting the railway telegraph service for the higher branch of commercial telegraphy, we find him occuping positions successively at Indianapolis, Cincinnati, Louisville, Memphis and Boston. While at Cincinnati, in 1867, he conceived the idea of transmitting two messages over one wire at the same time; this had been attempted by electricians many years before, but of this fact Edison was totally ignorant, and he continued to make experiments in every branch of telegraphy, attending to his office duties at night, and experimenting in the daytime.

In 1869 he left the operator's chair entirely, and came from Boston to New

York with a duplex and printing telegraph, the latter being the basis of nearly all the Gold and Stock Exchange reporting telegraph instruments. In New York he soon formed an alliance with electricians and manufacturers, and after years of varied experience with partners in the laboratory and in the shop, has finally and firmly established himself upon an independent footing in an extensive way at Menlo Park, New Jersey, where he is surrounded with everything which can contribute to domestic comfort or facilitate future invention and research. His property consists of a well-constructed and furnished laboratory with chemicals telegraph instruments of every description, etc., etc., in its comprehensiveness being second to no other establishment of the kind in the United States, having a factory with steam power for the construction of models; a foundry for casting iron and brass; a handsome villa, with stables and outbuildings, and comfortable cottages for his assistants and workmen. Among Mr. Edison's contributions to the telegraphic art, we find sixty patents and caveats assigned to the Gold and Stock Telegraph Company of New York, fifty to the Automatic Telegraph Company, and some thirty patents and numerous caveats for miscellaneous inventions; in all a total of one hundred and thirty-nine patents and sixty-seven caveats, and all taken out since 1870. He is joint inventor with E. A. Callahan, of the American District Telegraph instruments (the modern messenger service); inventor of the Domestic Telegraph system (another messenger service); inventor of the main features in the Gold and Stock reporting telegraph; inventor of the American automatic (chemical recording) system; inventor of a chemical recording automatic Roman letter printing telegraph; inventor of the celebrated quadruplex system now so extensively used by the Western Union Company; inventor of numerous forms of duplex telegraphy, and inventor of the Electric pen, which is fast becoming popular as a substitute for circular printing. Other inventions of more or less value, which it would occupy volumes to describe, are the product of Mr. Edison's genius.

The electro-motograph, for which he received the eighth patent issued by the United States for original discovery, would, of itself, give us a perfect system of telegraphy, were magnetism never discovered. It in fact offers the only other means of contributing motion (and controlling it) to mechanism at a distant point —the foundation principle of the electric telegraph.

This is regarded as Mr. Edison's greatest achievement, and one destined some day to prove of immense value. Its extraordinary delicacy may be appreciated when it is stated that in the course of one experiment it was made to give telegraphic signals through 70,000 *ohms* resistance by means of a battery current that through that resistance would not record a trace of itself upon paper steeped in a saturated solution of iodide of potassium.

The electro-motograph telephone is an invention based upon the above described principle of action, and is now demonstrating the marvelous range of action of this wonderful discovery, by transmitting the full compass of vocal and instrumental vibrations over an ordinary telegraph wire 200 miles in length, reproducing the tones with great accuracy.

Mr. Edison has also just perfected a speaking telephone, which reproduces the human voice over great lengths of line with marvelous accuracy and distinctness, by means of which conversation is carried on with great facility. Reiss, a German, Mr. Edison, and A. Graham Bell are the only persons who have ever grappled with this problem. Reiss, in 1866, succeeded in transmitting musical tones and some spoken words. Edison and Bell began experimenting in this direction about the same time, and each has succeeded in producing that which is characteristic of them. Bell's apparatus is the beautiful realization of a theory, but too receptive to outside or foreign electrical influences to be effective in their vicinity, and it is just there, in large cities netted with electric circuits, that the telephone is of value. Edison, using the regular battery, has a direct force commensurate with the work to be done and the foreign influences to be overcome, and can thereby give the volume of sound, and obtain the freedom from confusing effects, which brings effectiveness and marks his telephone with the practical stamp of all his inventions. Mr. Edison is also perfecting an automatic translator, which, when adopted, will prove of great value toward cheapening telegraphy. It will enable one operator to do the work now done by two. He is also engaged in perfecting a sextuplex by means of which six messages may be simultaneously transmitted over a single wire; and lastly, he has finished a machine for recording the human voice and reproducing it at any future time, by which we shall all be able to speak after we are dead.

The *North American Review* for May–June contains an elaborate article from Mr. Edison hmiself, upon "The Phonograph and its Future," from which we make the following extracts:

"The stage of the development reached by the several essential features of the phonograph demonstrates the following as *faits accomplis:*

1. The captivity of all manner of sound-waves heretofore designated as "fugitive," and their permanent retention.

2. Their reproduction with all their original characteristics at will, without the presence or consent of the original source, and after the lapse of any period of the time.

3. The transmission of such captive sounds through the ordinary channels of commercial intercourse and trade in material form, for purposes of communication or as merchantable goods.

4. Indefinite multiplication and preservation of such sounds, without regard to the existence or non-existence of the original source.

5. The captivation of sounds, with or without the knowledge or consent of the source of their origin.

The probable application of these properties of the phonograph and the various branches of commercial and scientific industry presently indicated will require the exercise of more or less mechanical ingenuity. Conceding that the apparatus is practically perfected in so far as the faithful reproduction of sound is concerned, many of the following applications will be made the moment the new form of apparatus, which the writer is now about completing, is finished. These

then, might be classed as actualities; but they so closely trench upon other applications which will immediately follow, that it is impossible to separate them: hence they are all enumerated under the head of probabilities, and each specially considered. Among the more important may be mentioned: Letter-writing, and other forms of dictation, books, education, reading, music, family record; and such electrotype applications as books, musical-boxes, toys, clocks, advertising and signaling apparatus, speeches, etc., etc. * * * * * *

Lastly, and in quite another direction, the phonograph will *perfect the telephone*, and revolutionize present *systems of telegraphy.* That useful invention is now restricted in its field of operation by reason of the fact that it is a means of communication which leaves no record of its transactions, thus restricting its use to simple coversational chit-chat, and such unimportant details of business as are not considered of sufficient importance to record Were this different, and our telephone-conversation automatically recorded, we should find the reverse of the present status of the telephone. It would be expressly resorted to *as* a means of perfect record. In writing our agreements we incorporate in the writing the summing up of our understanding—using entirely new and different phraseology from that which we used to express our understanding of the transaction in its discussion, and not unfrequently thus begetting perfectly innocent causes of misunderstanding. Now, if the telephone, with the phonograph to record its sayings, were used in the preliminary discussion, we would not only have the full and correct text, but every word of the whole matter capable of throwing light upon the subject. Thus it would seem clear that the men would find it more advantageous to actually separate a half-mile or so in order to discuss important business matters, than to discuss them verbally, and then make an awkward attempt to clothe their understanding in a new language. The logic which applies to transactions between two individuals in the same office, applies with the greater force to two at a distance who must discuss the matter between them by the telegraph or mail. And this latter case, in turn, is reënforced by the demands of an economy of time and money at every mile of increase of distance between them."

BOOK REVIEWS.

Fifth Annual Report of the State Board of Agriculture, of the State of Kansas, for the year ending November 30, 1876. Topeka, Kansas, Geo. W. Martin, Kansas Publishing House, 1877.

We have before had occasion to commend the wisdom of the State Board of Agriculture of Kansas in publishing complete monthly and annual reports of the condition and progress of the agricultural and horticultural interests in that State, instead of expending a much larger amount on an annual fair which would be of insignificant service compared with the substantial and permanent benefit derived from the admirably prepared reports, issued by the able secretary, Mr. Alfred Gray.

The present volume, comprising the Agricultural Report proper, that of the Academy of Science and that of the Centennial managers covers some 650 pages, and is undoubtedly the most interesting and valuable that has yet been published.

One of the most notable features of the Report is the publication of a map of every county in the State, each occupying a full page, and showing Government, Railroad, Agricultural College, and unsold lands, water courses, railroads, location of the school houses, township boundaries, &c., with a chapter correcting all of these points to the date of publication. Twenty-five pages are devoted to tabulated crop reports, one hundred and ten to a statement of industries by counties, and the remainder to meteorological, county, agricultural society, financial and other useful reports, which will be of the greatest service to the immigrant in making up his mind where to settle.

The whole work reflects credit upon the Board and its efficient and indefatigable secretary, whose health, we are sorry to learn, is seriously impaired. The mechanical work is well executed, making it an unusually presentable public document.

Canoeing in Kanuckia, or Haps and Mishaps Afloat and Ashore. By C. L. Norton and John Habberton. Illustrated. New York, G. P. Putnam's Sons, 1878. For sale by Matt. Foster & Co. $1.50.

This is a very interesting description of a summer canoe voyage down one of the tributaries of the St. Lawrence, by several literary gentlemen, with all the concomitants of hunting, fishings, upsets and misadventures necessary to make it attractive and piquant, combined also with a considerable amount of information upon the canoe building and sailing question. No one who commences to read this book will lay it down before he reads it through, and many a canoeing expedition will probably be the result during the coming summer. It is written in a very sprightly manner and cannot fail to handsomely repay its publishers, who have put it forth in a novel and attractive form.

Free Ships. The Restoration of the American Carrying Trade, by John Codman. New York, Putnam's Sons, 1878. For sale by Matt. Foster & Co. 25c.

This is the sixth of a series of essays or economic monographs, by representative writers on subjects connected with trade, finance and political economy.

In the monogram before us Captain Codman argues that the principal thing necessary for us to do in order to regain our carrying trade to foreign countries, is to cease protecting the American ship building industry, especially in steam vessels of iron, and buy our iron steamers of England, where they can be built so much more cheaply and better, thus putting ourselves on an equality with all the maritime nations of the earth except China.

The whole argument applies to a high protective tariff, and is worthy of full and careful consideration by our law makers.

Micrometrical Measurements of double Stars. 1877. Published by the Cincinnati Observatory, by Ormond Stone, Director.

It was discovered soon after the invention of the telescope that many stars that seem to the naked eye single, are in reality double. Dr. Hooke is credited by most astronomers with being the discoverer of the first double star. At first it was supposed that the duplicity of such stars arises from the accidental position of

two stars nearly on the same visual line, but an inquiry by Sir Wm. Herschel into a subject of great interest connected with another branch of astronomy, led to the recognition of the fact that most of the double stars are really pairs of physically associated bodies. He found to his surprise that in many instances the smaller of the double stars revolved around the larger, making in fact a system. This has been confirmed by later observations, and within a comparatively short time much attention has been directed to this subject of double stars and their micrometrical measurements. Sir John Herschel, Sir James South, William Struve of Prussia, Argelander, Mitchell, and still later Burnham of Chicago, Howe, Upton, and Stone of Cincinnati and other noted astononomers have devoted much time to this interesting study. The present report gives a list of 930 observed and measured by the last named three gentlemen.

WASHINGTON COUNTY, OHIO, and the Early Settlement of Ohio, by Israel Ward Andrews, LL. D., President of Marietta College. For sale by Wm. Holden, Marietta, O. 40c.

This is the Centennial historical address prepared in accordance with the recommendations of the Centennial authorities of Philadelphia, and is most admirably written and arranged. Very few men in Ohio are as well calculated as President Andrews to do such a work, and to those interested in the early history and progress of that State, as well as of Washington county, it will prove most valuable and intensely interesting.

ELEVENTH SESSION OF THE PRESS ASSOCIATION OF MISSOURI. Compiled by Chas. E. Hasbrook, late Secretary. Ramsey, Millett & Hudson, Kansas City, 1878.

This is a synopsis of the proceedings of the convention of Missouri editors last year at Fredericktown, with the orations, essays and poems produced in full, including that of the late Senator Bogy, which was read by Hon. B. B. Cahoon. The work of compiling has been very thoroughly done by Mr. Hasbrook, who is now one of the vice-presidents of the Association, and the mechanical work is exceedingly tasteful and attractive.

EDITORIAL NOTES.

The *Western Homestead* for May 1878, quarto 34 pps., $2.00 per annum monthly, was received too late for notice.

PROF. T. GAILLARD THOMAS, M. D., in the *New York Medical Monthly* for May proposes the injection of fresh milk into the veins as a substitute for the transfusion of blood in cases of sudden loss or gradual depreciation of the vital fluid; arguing that fresh milk and the chyle which is constantly mixed with the blood and is utilized for nutrition, are similar and closely allied to each other, besides, that the injection of milk into the veins is infinitely easier than the transfusion of blood.

PROFESSOR NIPHER of St. Louis, and Professor Snow, of the Kansas University, are devoting close attention to meteorological observations in their respective States. Indeed such observations are becoming systematized all over the country and must result in a comprehension of natural phenomena far superior to anything hitherto enjoyed by meteorologists.

We are indebted for complimentary mention of the Review to the veteran Botanist, Prof. Leo Lesquereux, of Columbus, Ohio; Captain H. W. Howgate, of the United States Signal Corps; Prof. Spencer F. Baird, of the Smithsonian Institute; Prof. F. H. Snow, of the Kansas University; Prof. Osborn, of the State Normal School at Warrensburg, Missouri, and to many other friends, both professional and editorial, in different portions of the country.

As an evidence of the growing importance and value of the Review among scientific men we may be permitted to state that we have since our last issue received original communications from New Haven, Ct., Rhode Island, Washington, D. C., Colorado, Iowa, Kansas and Missouri, besides those of the members of our own Academy of Science that appear in this number.

Prof. C. W. Irish, of Iowa City, kindly sent us an article on the Transit of Mercury, but as we had one already in print which covered substantially the same points, we reluctantly omitted it.

The Editorial Convention of Missouri meets at Springfield on the 21st day of May, and it is expected that it will be the largest and most interesting meeting of the kind ever held in the State.

The explosion of the flouring mills, of Minneapolis, on the 2d of May, resulting in the total destruction of the Washburn Mill, the largest on this continent, and several others, with the loss of nearly twenty lives, was attributed to the ignition of gas generated in some unknown manner by the middlings purifiers. To us this seems an absurd as well as an unnecessary theory. If the real cause is ever ascertained we have no doubt that it will be found to have been the sudden ignition of the immense amount of flour atoms floating in the air, just as such explosions have been caused in other mills on a smaller scale, in coal mines where the atmosphere was filled with floating atoms of inflammable coal-dust, and as we believe, in the candy factory blown up lately in New York City.

Prof. Patrick, of the State University of Kansas, has recently discovered within three hundred miles of this city great quantities of Phosphate of Lime. It will not be needed much in Kansas or Missouri for many years, but as an article of commerce its value is inestimable.

The *Scientific American* of April 20th gives an illustrated account of the sailing car devised by Mr. C. J. Bascom, of the Kansas Pacific Railway. As this car has been in use several years, it is no novelty in this portion of the West, but doubtless the description will excite considerable interest among our eastern friends.

More than twenty years ago "wind wagons" were tested on the prairies of Kansas, and considerable rates of speed attained; but it was found that owing to friction and uneven surfaces it was impracticable to transport large enough loads of freight to make their use any object to the plains-man, and they were abandoned.

The Kansas State Academy of Science will hold its semi-annual meeting in this city, June 6th and 7th. A very numerously attended and interesting meeting may be expected.

The telegraph poles in Java are formed of the trunk of a tree called the "Kapas," which possesses the advantages of taking root and sending forth branches when set into the ground, thus defying the white ants which would rapidly destroy a dead trunk, and of sending forth their branches in a horizontal direction, so that they not only do not interfere with the wires and insulators, but are handsome and of course durable.

The detection in water of gelatine is of serious moment as affecting its purity as a wholesome drink. The test solution used by Kaemmerer consists of 2 parts of tannin, 1 part of sugar, 3 parts of water, and 5 of alcohol, and when gelatine is present it causes a flocculent deposit. The presence of this substance is due to the development of certain forms of microscopic vegetation, the decomposition of which causes a very dangerous impurity when in sufficient quantity.

THOMAS HELLAR, of Sedgwick county, Kansas, has discovered a valuable bed of peat upon his farm. He says the deposit is from four to fifteen inches thick and entirely free from sand and dirt, and that the lower half of the bed is extremely compact. He estimates that in that single bed there is fuel enough to supply the neighborhood for fifteen years. The bed lies between a precipitous bluff and the bank of the creek, in a half circle containing several acres. From the foot of the bluff a spring of water, a large volume of which pours out as thick as a man's arm, is situated. Underneath the bed of peat is clear sand. He thinks other equally valuable deposits will be discovered. It burns perfectly leaving only a small residue of white ashes. His sons are mining or taking it out and stacking it up to dry, having put in a thorough drain.

DR. SHŒPNER, of Berlin, recently delivered a lecture at Berlin, which has been translated by Madame Blavatsky and published in the Supplement of the *Scientific American*, to prove that our globe neither rotates upon its axis nor around the sun. Almost simultaneously "Brudder Jasper" of the African Methodist Episçopal church delivered a discourse in which he undertook to prove that the earth is square and the sun moves around it.

THE May-June number of the *North American Review* contains the following articles: "Is the Republican Party in Its Death Struggle?" by Senator T. O. Howe; "The Sovereignty of Ethics," by Ralph Waldo Emerson; "Our Commerce with France," by J. S. Moor; "Discipline in American Colleges," by James McCosh, President of Princeton College; "The Army of the United States," by Gen. James A. Garfield; "Is Man a Depraved Creature?" a debate, by Rev. T. W. Chambers, D. D., and Rev. O. B. Frothingham; "The Irrepressible Conflict Undecided," by Senator A. Cameron; "Chinese Immigration," by M. J. Dee; "The Phonograph and its Future," by Thomas A. Edison, the inventor of the instrument; Contemporary Literature. Published at 551 Broadway, New York, and for sale by booksellers generally.

A NEW edition of Prof. Jordan's "Manual of the Vertebrates of the United States" is in progress. It will be enlarged by the addition of nearly one hundred pages, and in it the nomenclature will be brought fully to date of publication, and all the lately discovered species made known by our active band of ornithologists are included. The fishes are entirely re-written; all the genera are fully and *exactly* characterized, many of them for the first time, and the names used are those adopted by the Smithsonian Institution, the U. S. Fish Commission and by the Government Surveys. Natural diagnoses have been in the fishes everywhere substituted for the artificial keys, the application of which is often unsatisfactory and uncertain.

An addenda includes descriptions of all American species of Salmon and Trout, embodying results of the latest researches conducted by Professors Gill and Jordan, under the auspices of the U. S. Fish Commission. Previous to this no person living knew anywhere near how many species we had in America, what the boundaries of these species were, or what name any of them ought to bear. This feature of the book ought to commend it to anglers.

A list of the works on American Vertebrates, which has been found most useful to the writer, is included, which students wishtng to begin original work will find a valuable guide to the scattered literature of the subject.

A glossary of specific names used for our Vertebrates is a novel feature, which will be appreciated by all students who wish to know what the scientific names mean and why they are applied.

The work has the hearty approval of Prof. Baird, Prof. Cope, Dr. Coues, Dr. Gill, Prof. Allen, Mr. Henshaw. Prof. Ridgeway, Prof. Forbes, Dr. Wilder, Prof. Goode, Dr, Yarrow, Prof. Milner, and of the best students of American Vertebrates generally. It will be published immediately by Jansen, McClurg & Co., Chicago.

PROF. NIPHER, Director of the Missouri Weather Service, publishes with his Report for April 1878 a complete set of observations of the rainfall in St. Louis by months from 1839 to 1877 inclusive, made and recorded by the veteran observer Dr. Englemann of that city, by which, among other things, it appears that in 1858 the greatest amount of rain (68.83 inches) fell, and in 1871 the smallest amount, (21.87 inches.) Also that in Nov. 1876 the greatest amount fell for any one month, viz. 11.55 inches, and in November 1865 the smallest, 0.00 inches.

THE percentage of verifications of the U. S. Signal Service predictions for March 1878 were as follows: 87.0 for New England; 88.8 for the Middle States; 87.6 for the South Atlantic States; 79.5 for the Eastern Gulf States; 81.7 for the Western Gulf States; 87.4 for Tennessee and the Ohio Valley; 87.2 for the Lower Lake Region; 87.4 for the Upper Lake Region; 86.6 for the Upper Mississippi Valley, and 84.6 for the Lower Mississippi Valley. By elements the percentage verified averages 88.8 for the weather; 85.6 for the direction of the wind; 87.6 for the temperature, and 81.8 for the barometer, all of which is pretty good guessing for "Old Probs."

WE regret very much the article on the "New Mounds" discovered near Warrensburg was received too late to have the drawings which accompanied it engraved. Several of them were very remarkable representations, and were skillfully executed by the writer.

VOLUME II, Part I, Proceedings of the Davenport Academy of Natural Sciences was received from Mr. Putnam, the corresponding secretary, too late for notice in this number of the REVIEW. It is a handsome volume of 148 pages octavo, illustrated. Price $1.50.

THE silver mines of Woodson county, Kansas, are attracting considerable attention at present. The Silver City Mining Company have struck a lead in their shaft at thirty feet, containing silver, dipping to the north at an angle of forty-five degrees; they passed through it and are down forty-two feet and intend to go down sixty feet, and then tunnel to the vein.

Dewald & Co. are down forty feet, but have come up in their shaft to about twenty-eight feet, and are tunneling. They are taking out ore said to contain silver and copper.

THE Kansas State University holds its annual commencement exercises on May 27th, 28th, 29th and 30th. Gen. C. W. Blair, of Fort Scott, has been chosen to deliver the oration. Usually the commencement exercises are very attractive and interesting, and we presume this year will prove no exception to the rule.

AN excellent opportunity for the observation of the phenomena attendant upon full solar eclipses will be furnished in the United States by the eclipse of the 29th of July next, as this will be total in the western part of North America and in the island of Cuba. The longest duration of totality will be in the southeastern part of British Columbia; and in the states on the western slopes of the Rocky Mountains, in parts of which the time of totality will exceed three minutes. It is suggested that at or near Denver will be the best place of all for the observation, as it is very easily reached, and the sun's altitude at the time of the eclipse will be quite considerable.

THE closing exercises of Missouri University, for 1878, will take place as follows: May 27th, to June 5th, Wednesday, public examinations. June 2d, Sunday, Baccalaureate Sermon, by Rev. David R. McAnally, D. D., of St. Louis. June 3d, Monday evening, Address to the Medical School, by Prof. P. Gervais Robinson, M. D., of St. Louis; also valedictory of the class and delivery of diplomas. June 4th, Tuesday evening, annual oration before the literary societies, by Col. John F. Phillips, of Sedalia. June 5th, Wednesday evening, oration before the Alumni Association, by Joseph V. C. Karnes, of Kansas City.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY

A MONTHLY RECORD OF PROGRESS IN

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VOL. II. JUNE, 1878. NO. 3.

CORRESPONDENCE.

CAPT. HOWGATE'S POLAR COLONY.

BY W. DE FONVIELLE.

Letter to the Members of the Central Committee of the Geographical Society of France.

TRANSLATED BY MISS IDA HOWGATE, WASHINGTON, D. C., FOR THE WESTERN REVIEW.

GENTLEMEN: I have the honor of presenting to you three pamphlets, in the name of Capt. Howgate, assistant to the Signal officer at the Washington Signal office; the first contains the plan for the establishment of the polar colony which this officer intends to establish on the borders of Lady Franklin's Strait, the favorable report which was made on his proposition the 8th of January, 1877, to the United States Congress by Mr. Willis, in the name of the Committee of Naval Affairs; in short, several letters of approval, particularly that of Mr. Daly, President of the Geographical Society of New York, and of Prof. Elias Loomis, the celebrated meteorologist of Yale College.

The second, entitled "Correspondence and action of the scientific and commercial associations in reference to the establishment of a polar colony," comprises the assigned approval of several celebrated and competent persons, among whom it is sufficient to mention Mr. John Ral and Mr. Julius Payer, whose names are intimately connected with the polar regions, where they have acquired

an immortal reputation, and Mr. Joseph Henry, the time-honored director of the Smithsonian Institute.

The third gives an account of the preliminary expedition, of which the command has been intrusted to Capt. Tyson, and all the details which have come to Europe at different times and which needed to be reunited in the same publication. Capt. Howgate has added to it a copy of the instructions given to Mr. Sherman, meteorologist of the expedition, and to Mr. Kumlein, naturalist, especially commissioned with the study of the animals, plants and geology, as well of the countries adjacent to the seat of the polar colony, as of those which will become ports or winter-harbors.

Capt. Howgate informs me in his last letter that he is occupied in preparing a new pamphlet, in which he will enlarge and complete the plans already stated several times. He will naturally make them undergo several important modifications for the purpose of taking into consideration some observations which have been addressed to him, or some studies to which he has devoted himself for more than a year. It is these plans, amended and improved, which he will submit to the United States Congress in its present session—and this formality is perhaps complied with, even at this hour. I beg the Society, then, not to consider the documents which are submitted to it as presenting the decisive expression of Capt. Howgate's plans.

But, at the same time, I will take the liberty of requesting it not to await the arrival of documents which will not change the essential basis of the expedition, and to express its opinion upon the information that I have at my disposal and which my correspondence with Capt. Howgate will permit me, if it is necessary, to complete, at least in different parts.

I cannot help hoping that the favorable opinion expressed by a Society whose influence increases every day, which possesses so many scientific illustrations of all descriptions and which has always shown such solicitude for the solution of polar questions, will exercise a favorable influence on the decisions of the United States Congress. It would be very consoling to think that if the state of our finances does not yet permit us to get up a French expedition, the country of Jules de Blossville, of Francois Belot and of Gustave Lambert will not remain alien to the great attempt which is going to be accomplished and whose execution has already begun. In fact, the *world* knows that Capt. Tyson winters at this moment on the banks of the Cumberland Gulf, at a point whose exact latitude and longitude will be made known at Washington by the first dispatches received on the opening of the ice. It is foreseen that a decision of the Geographical Society would facilitate the vote of Congress. Permit me to respectfully urge it in order that the news may arrive in time to be useful on the other side of the Atlantic.

I will add that the approbation given to Capt. Howgate's plan will not prejudice in any way the plan of the polar international expedition proposed by Count Wilzek and Mr. Charles Weyprecht and which would have been, as you know, discussed by the International Meteorological Congress at Rome in September,

1877, if political events had not obliged the convocation to adjourn till the next year.

The colony at Lady Franklin's Bay must be considered as a beginning of the execution of this universal plan and consequently I am not afraid to say that your adherence to it is obtained. If the American station is found to be placed in a more elevated latitude than the Count Wilzek and Mr. Weyprecht wish, it is only because the expedition of Capt. Nares had the good fortune to discover, before sailing for England, a rich coal mine, the intelligent working of which will enable the rigors of the severest climate to be endured. These natural treasures belonging to the first occupant, we cannot complain that the compatriots of Capt. Hall insist that the stars and stripes shall float on the shores where we can, so to speak, see the tomb of the great explorer.

The magnetic observations will be carried on in the polar colony with the same regularity and in the same manner as in the large observatories of America or of England. Perhaps use will be made of recording instruments.

The means which will be placed at his disposal allowing him to do it, Capt. Howgate will not neglect a precaution so essential for seizing the precise moment of the disturbances and determining with exactitude the relation connecting the extraordinary movements of the magnetic needle with the apparitions or paroxysms of the aurora borealis. I have not been able to discover, in the long enumeration of precautions recommended by Messrs. Payer and Weyprecht, any precaution that Capt. Howgate has omitted in his programme.

The future station of the colony at Lady Franklin's Bay will therefore furnish observations comparable with those that might be collected later in other analogous establishments as to the questions of magnetism, electricity, rain, wind, etc. The only serious difference will consist in the hour of the individual observations, for the chronometers of the colony will be regulated by Washington time. To be sure, Capt. Howgate attaches a special importance to the readings which correspond to the passage of the sun in the meridian of Washington. Indeed, it is known that this moment has been chosen for the universal observations established by American astronomers. But this particular cannot create any serious difficulty, for it may be inferred that Messrs. Payer and Weyprecht will introduce this important observation in the fine programme which they have made out with such remarkable care and ability.

An important change has been stated by Capt. Howgate in the programme of the preliminary expedition. Instead of being confined to establishing weathercocks, whose course is always uncertain, and which, moreover, only indicate the movement of the strata near the surface of the earth, Capt. Howgate has given the order to launch in the air small guide balloons whose course will be observed with care and recorded as regularly as the barometer or thermometer measures.

It is to be regretted that notwithstanding all the efforts which have been made in France to spread this method, and the creation of a service of aerial communications by the War Department, it has not been adopted by one of our obser-

vatories, where the directions of winds continue to be studied in the most imperfect manner—as if air-balloons had not been invented.

I will take the liberty to remark on this point, that small guide balloons, being constructed scientifically, can be carried by the winds to immense distances. The history of balloons furnishes several examples of it, and that of the siege of Paris would suffice to establish victoriously that free air balloons launched from the Cumberland coast or from the polar colony would have strong chances of reaching even civilized countries, where a few of them could be collected. It is not necessary to enter into long explanations to show that this manner of proceeding may be considered as very superior to the ancient practice of intrusting closed bottles to the waves of the ocean. Yet it is unnecessary to suppose that in the actual state of aërostatic knowledge it would be possible to start from the polar colony air balloons equipped with the view of reaching the polar regions. The plan proposed by a captain in the English Navy has no connection with the projects of Capt. Howgate.

While proclaiming the necessity of finding some means of utilizing atmospheric communication on the borders of the eternally frozen sea, where the course towards the pole will always be so uncertain and slow, the cautious American officer has understood well that it is necessary to proceed in a methodical and sure manner in a question so new. He has taken great care not to fall into the traps of those quacks who prepare inevitable shipwrecks in presenting to the public or even to the government projects of which we hear so often and which bear the imprint of rashness and of ignorance.

The founder of the polar colony would have wished to organize some free and captive ascents on the border of the polar sea, in order to profit by favorable aërial currents to advance towards the north and return towards the south, much the same as the French aëronauts have succeeded in doing on the borders of the Mediterranean or of the ocean.

But after having examined the means which the expedition had at its disposal, it has been found that a gasometer of only eight feet in height and eight feet in diameter, could be constructed in the polar colony, which would be unable, consequently, to render any service in the inflation of air balloons of from two to three thousand metres cubic, the smallest that can be adopted for so difficult a service. Whatever may be the means used and the process employed for preparing pure carbonated hydrogen gas, a magazine of gas of so feeble a capacity would be no help even in our climates. They would not be satisfactory even for traveling ascensions.

What sincere aëronaut would risk preparing his gas in proportion as it should be introduced into the balloon, unless he resigned himself to prepare it by the action of acid on iron in the apparatus for continuous production by Mr. Henry Giffard. But if it were done in this manner, it would be necessary to carry to the polar regions a full cargo of sulphuric acid and iron.

If we hesitated at this extreme expedient, use could not be made of the air balloon without having resolved another problem not less difficult.

It would be necessary to keep the balloon inflated until the moment when the atmospheric circumstances would permit of trying the ascension with reasonable chances of returning towards the south after having been carried more or less towards the north. During probably a very long time, it would remain exposed to winds of extreme violence.

But the necessity of preserving a balloon in such circumstances is precisely the greatest of all difficulties which will have to be surmounted in order to use air balloons in the polar regions, as it is only too easy to understand.

For the air balloon which could keep up in the air whose envelope would have a stability sufficient to resist the most violent wind, could float during the entire summer above the polar regions, touch the earth in a multitude of different points, and terminate its voyage near a place of safety. Such a programme would cease to be beyond human power, especially if these countries, where modern civilization struggles with such gigantic difficulties, were marked out by numerous scientific colonies which the spirit of progress will not delay to create there.

I believe, then, it is necessary to encourage and assist Capt. Howgate in all the researches which have for their object the study of the distribution of aërial currents at the north pole, not only with the view of enlarging our meteorological knowledge, but also with the intention of using them in future aëronautic expeditions.

Indeed, the discovery of circumstances exceptionably favorable, such as the existence of regular land and sea breezes would be, might lead to accumulating even in the colony at Lady Franklin's Bay, some means of inflation which would not have been thought of at the beginning of so important a foundation.

While stating with regret, that for the moment we cannot do more, it seems to me that we ought to congratulate Capt. Howgate for having introduced air balloons, even under the form of simple exploring balloons, in a region where sooner or later they will permit us to approach the solution of the most redoubtable mysteries.

I hope, for my part, that by the help of information collected by Capt. Howgate, we shall be able at the close of the Universal Exposition to propose to the government the adoption of a reasonable plan of aërostatic operations, taking as a basis either the polar colony of Capt. Howgate or those whose foundation will have been decided, according to all probability, at this date.

In response to this eloquent appeal of M. de Fonvielle, the Geographical Society addressed the following communication to Capt. Howgate as evidence of its interest in the subject of Arctic Exploration.

GEOGRAPHICAL SOCIETY OF FRANCE,
No. 3 CHRISTINE ST., PARIS, Jan. 31, 1878.

CAPT. H. W. HOWGATE, *U. S. Army, Washington, D. C.*:

The Geographical society of Paris watches with the liveliest interest the efforts which have been made in the United States to organize a Scientific Colony in the Polar regions of the north, and it will commend every resolution of Congress favorable to the project in which you have taken the initiative, and which, thanks to

the aid you have already procured from intelligent compatriots, is already in process of execution.

The Society thinks that your idea of establishing a polar colony cannot fail to produce results emimently useful to science, and that, while permitting the indicated observations to be made, it will hasten the geographical conquest of the polar regions.

The Society follows with its most sympathizing wishes Captain Tyson, in the preliminary expedition with which you have charged him, and its good wishes will likewise be yours, the day when at the head of the expedition, you have profited from the results obtained by the commander of the Florence and his brave fellow voyagers.

In thanking you for the active part you have taken in the preparation of this polar campaign, we pray you, sir, to be pleased to receive the expression of our most distinguished consideration.

C. DE QUATREFAGES,
President of the Central Commission, Member of Institute.

C. MANNOIR,
General Secretary.

DE LA RONCIÈRE-LE-NOURY,
President of the Society, Vice-Admiral and Senator.

SCIENCE LETTER.

PARIS, FRANCE, May 11, 1878.

According to La Rochefoucauld, jealousy betrays more self-love than love; only small minds are vain, and from vanity to jealousy is but a step. Is there an abyss between jealousy and madness? Dr. Moreau asserts, no; for him, jealousy is a disposition wishing to be the sole possessor of an object. Pushed to excess, it can become a monomania, and thus lead to redoubtable and uncon scionable acts. He classes the jealous among the class of incomprehensible-patients; as the case of a husband, persecuting his wife with unfounded suspicions, or a mother, envying the beauty, gracefulness, and success of her daughter.

Of all the uses to which needles and pins have been applied, that of converting them into something like an article of consumption, is the strangest. Yet there are people who devour them passionately, and by dozens, as if they were oysters. Some prefer needles, others have a marked taste for pins—those especially of the small, white pattern, with round heads. Not less extraordinary is the facility with which these foreign bodies circulate through the tissues, and across organs more or less long. At the end of several months, or years, the needles and pins arrive beneath the skin, from which they are extracted as a needle sunk to the eye in a pin cushion. Not only do inmates of asylums exhibit a partiality for swal owing these substances, but persons sound in body and mind, also. Silvy quotes the case of a woman, in robust health, who had a passion for swallowing pins and needles, 1,500 of which were found in all her organs after death. Villars relates the instance of a woman aged 26, who, in the space of

seven months, rendered by her skin, more than 200 needles and pins. The latter "came to the surface" more rapidly than the former, and the needles are generally rusty. The head, the arms, the abdomen, the armpits, and the legs as far as the knees, are the parts where these substances "exude." Dr. Otto has found them in veritable nests below the skin, forming bumps, containing 100 pins, etc. The latter are often extracted at the rate of 20 to 60 per day, and never accompanied by bleeding; occasionly pain precedes their arrival. When the needles in gliding through the muscular tissue, encounter a hard obstacle or a soft organ, some nervous accidents may ensue, terminating fatally; gastric derangements are mostly to be apprehended. There is a case recorded of an individual who swallowed a pin, and after a sojourn of 42 years, it was expelled by the bladder.

A central administration supplies the Paris hospitals with bread, beef, &c. The bread is very white, and pleasing to the eye, but devoid of taste, and positively insipid after 24 hours. Dr. Blachez, invited to suggest ameliorations in the dietary of the hospitals, denounces the universal plan of soup and boiled beef. He agrees with Brillat-Savarin, that "boiled beef, is only meat less its juice," and that the resulting soup or broth, stimulates the taste, but does not nourish the body. It is an error to view broth, according to the Dr., as either a quintessence or an extract; the *musculine*, or alimentary portion of meat, is profoundly altered by ebullition, according to Messrs. Robin and Verdeil. There are patients who require beef-tea as a drink. Dr. Blanchez would not have the residual meat consumed in the hospital, but sold to low-class eating houses, that could mix it with vegetables and fatty matter, to suit robust appetites. For hospital diet then, roast, not boiled, should be the form in which meat ought to be served to the sick.

Maize is too important a matter in alimentation not to be carefully studied under every aspect. M. Fua, of Padua, a celebrated botanist, is a warm advocate of this grain, asserting that it is as rich as wheat in muscle-forming elements, besides containing four times more fatty matter. In a word, maize contains in itself all the substances necessary for repairing organic losses, without the aid of complementary matters. Its sedative-producing effects are so notorious that the French authorities are experimenting with maize bread, for the inmates of prisons and hospitals. It is remarked, that the inhabitants on one bank of the Po, are proverbial for the tranquillity of their character—the consequence of living on maize, while their neighbors on the opposite bank, are notorious for their quarrelsomeness. All parties agree that maize has one draw-back, it produces a disease named by the Spaniards *pellagre*, a cutaneous eruption, followed by intestinal ulcerations, and nervous disorders. This malady according to Dr. Gubler, is due to a fungus, a kind of ergot, of a green color, possessing venomous properties, and peculiar to *damaged* maize, and Turkish wheat, especially if harvested during damp weather. In the southern regions of France, *pellagre* was

at one time very prevalent, but by kiln-drying the grain, the mushroom was destroyed, and with it the source of the disease.

The influence of light upon plants and animals, has, up to the present, only been summarily examined by science; hence, the greater reason for probing this delicate and difficult subject. The chief impediment to the study of the matter arises from the complex nature of light itself. What are the active, what the inert rays, for the properties of light change following the nature of the rays? Professor Paul Bert has devoted lately much attention to the problem. In the last century, Priestly discovered that the green parts of plants, exposed to solar light, decomposed the carbonic acid of the air, appropriating the carbon, and liberating the oxygen. The green parts of plants are thus chemical re-agents, and at the same time, reservoirs of carbon. The longer the duration of sunlight, the more rapid is vegetation. Wheat in our latitude requires from 130 to 140 days to ripen, while in Norway 90 to 100 suffice. In the north, the influence of the sun is longer in its daily duration, though its rays are at the same time more oblique.

M Bert has studied the action of light on the sensitive plant. He denies, in opposition to the popular belief, that the leaves close on the approach of evening, similarly as if they had been touched by the hand. On the contrary he finds that from nine in the evening after drooping, they re-expand, and attain the maximum of rigidity at two in the morning. This rising and falling, is the ordinary process of their daily life. The so-called sensitiveness of plants, is but the external physical manisfestations of the influences of light. Bear in mind the plant is a complex laboratory, forcing carbon in its green parts, burning it in the non-green tissues. M. Bert placed plants in lanterns of various colored glass; those under the influence of green panes, drooped in the course of a few days as completely as if plunged into absolute obscurity. The explanation is simple: the green rays are useless, and hence equal to none at all. In some weeks, all plants without exception thus dealt with, died. M. Zimiriareff's experiments prove that the reducing power of the green matter of plants is proportionate to the quantity of red rays absorbed, and Paul Bert demonstrates, that green glass precisely intercepts these colored rays, and that plants exist more or less healthily in blue and violet rays. For horticulturists, the practical conclusion is, avoid green glass. In the Botanical Gardens of this city, the Vanilla, in a hot-house covered with green glass, was sickly and never flowered; the house was battered by a shell during the siege; the building was repaired with white glass, and since then, the Vanilla is robust, and flowers. Similar observations apply to the fernery. In the animal world, phenomena of a directly opposite nature are to be noticed, and of a more complex character; here the light acts on the skin and the movements of the body, either directly, or through the visual organs. M. Pouchet has pointed out the changes in color that certain animals experience, following the medium in which they live. Thus young turbots reposing on white sand, take an ashy tint, but become brown when resting on a black bottom; when the fish is deprived of its eyes the skin exhibits no change of color; the phenomenon is thus nervous

or optical. The chameleon's color does not alter following the color of the position where it rests; but when acted upon by the sun's rays, it assumes a tone more or less deep, passing from an apple to a bottle green, and brown. M. Bert placed a piece of paper with a cut design, on the back of a sleeping chameleon; on bringing a lamp near the animal, the skin gradually became brown, and on removing the paper, a well-defined design appeared, Here light acted directly, and without any nervous intervention. However, if an eye of the chameleon be extracted, the corresponding side of the animal becomes insensible to the influence of light. M. Bert concludes, that light must affect the circulation in the transparent layers of our skin.

This may explain why some doctors recommend weakly children to be kept well in the light, and to allow the latter to enter freely wherever possible in sick rooms. Possibly the good effects of not covering the neck, arms and legs of children may be attributed also to the same cause. A sun-stroke, according to Dr. Bouchard, is the effect of the direct action of light upon the skin, produced by the blue and violet rays. The heat-producing rays have no part in the accident, as workmen exposed to intense heats do not feel their fatal effect. M. Bert has experimented on a variety of animals, from the microscopic daphnia of ponds ranging up to man; none fled the light; all sought it, and the lowest like the highest, absorbed the same rays. There was a difference respecting the intensity of color, some being more partial to one ray, than to another. The daphnia had a weakness for yellow; violet was in less request; spiders felt happier in blue than in red rays—resembling thus people suffering from Daltonism. No two persons, while absorbing the same light, are sensible to the same shades or tones; thus indicating that the retina of the eye has a selective power.

When in the neighborhood of telegraph posts and wires, we hear a buzzing or singing noise. M. du Moneel denies that this is due to "earth currents," but to the action of heat on the wires; the buzz is loudest during serene weather, and the currents flow in different directions, following the day or night. Professor Gressier announces that the telephone, whose wires run over the same poles, reproduces the same sounds, in the evening especially, and so intensely, as to create the belief that the telephone plate is going to break. He does not think the matter is connected with the simple transmission of sound, but of veritable currents originating in the upper regions of the atmosphere, relatively to the position of the observer.

M. Salathé gives the results of his experiments as to the influence on the brain from the point of altitude of animals. Many weak persons suffer extremely, when passing from a horizontal, to a vertical altitude. M. Salathé placed some rabbits head upwards; in three quarters of an hour death invariably ensued; the movements of the heart and lungs diminished; the pressure in the vessels of the superior parts of the body became less, while increasing at the opposite extremities. When replaced in the horizontal position, the rabbit speedily recov

ered itself. But what will surprise many is the fact, that when an animal was placed head downwards, it supported that position by living for several hours—the respiratory movement alone being accelerated. This may explain how acrobats can "stand on their heads" for so long a time with impunity.

In the south-west of France there are extensive beds of phosphorites worked in the interests of agriculture. M. Filhol, a very rising geologist, has examined these mineral phosphates, formed by clefts in the soil, which subsequently became filled with water holding the phosphorite in solution. The earthy layers surrounding the nodules are full of well preserved organic remains, such as the lemur, analogous to the galago of Senegal; the reptiles correspond with species at present to be found in Africa, and the mollusks indicate a climate warm and humid, similar to that of Indo-China.

Water is composed of two gases—hydrogen, a combustible, and oxygen, the supporter of combustion. Science has been for years engaged endeavoring to decompose water, and turn its constituent gases to account as a source of cheap fuel. The processes have hitherto been costly, tedious, and difficult, by dissolving the fluids, slightly acidulated, by means of an electric current, or passing steam over incandescent coke. A new plan is announced: Forcing a volume of steam through a kind of oven heated red hot, and later, allowing it to escape over an incandescent plate where the oxygen is liberated and the hydrogen collected and stored. After the telephone and phonograph, science has no occasion to despair.

M. LeBlanc shows that when a person commits suicide by means of charcoal fumes, it is not the carbonic acid that suffocates, but the oxide of carbon gas, which, seizing a second moiety of oxygen from the globules of the blood, deprives the latter of its normal supply and asphyxia ensues. Hence the importance of fresh air for crowded rooms, and the necessity to avoid stoves, *braseros*, and smoking saloons, where combustion and its namesake, respiration, being incomplete, the oxide of carbon draws its deficient oxygen at the expense of our circulation, that is to say, our health and our life. F. C.

EDITORIAL CORRESPONDENCE.

SPRINGFIELD, MO., May 24, 1878.

WESTERN REVIEW:—The editorial excursion to this place has been so far a perfect success. The weather has been pleasant, and the ride over and through the somewhat mythical Ozark mountains has been exhilarating in the extreme. Our reception by the hospitable people of Springfield was courtesy itself, and everything has been done by the editorial fraternity, the ladies and the whole populace to render our stay agreeable and profitable; and we have enjoyed it.

The county of Greene lies upon the summit of the Ozark mountains, which here attain an elevation of 1,500 feet above the Mississippi river at St. Louis. It

is an eminently agricultural region, though lead and iron are believed to exist in paying quantities. The commercial interests of Springfield are more fully developed than those of almost any other city in State, there being some twelve or fifteen flouring mills, nearly as many saw mills, with factories of all kinds, including a cotton mill in successful operation. Being the center of a very large agricultural district not very fully provided with railroads, it is the headquarters of a very heavy inland trade, extending throughout Southwestern Missouri and Arkansas.

The most interesting features of the country to the naturalist are the numerous springs of mineral and other waters and the caves, found in several directions near the city. About seven miles northwest is Knox cave, which has been explored more than a mile, and varies from twenty to seventy feet in width, from six to thirty feet in height, and is from seventy-five to one hundred feet below the surface of the ground. For some distance from the entrance it passes through the limestone rock and is hung with the most beautiful stalactitic formations constantly dripping with water.

Fisher's cave, six miles southeast of Springfield, is similar in dimensions, and has a fine brook flowing out of it. There are several large rooms in it connected together, some of which have not yet been fully explored. It is a favorite resort for pleasure parties, as is also the natural bridge which is about five miles south of Springfield in the same direction. Near Cave spring there is another natural bridge, through which pours a beautifully clear stream of water.

Near Ash Grove, about twenty miles west of Springfield, on the Springfield & Kansas City railroad is a most magnificent and colossal cavern, with "rooms, corridors, halls and gangways, full of beauty, grandeur and sublimity. One opening is a large circular hole about forty feet deep, down which the descent is very steep. Another opening leads in from the river, and is about eighty feet broad with a finely arched roof, the floor being composed of large flat rocks. It is the most beautiful place for a picnic in the State, and will accommodate five hundred ladies and gentlemen. The water from the spring near town runs through the hill into the river, and after a heavy rain huge floods rush through the cave, leaving in their wake the debris of wrecked trees and moving mountains. About a mile below this, on the river, is another cave, much larger and grander than this, which is yet to be explored. And there are still others in the vicinity; in fact the hills are full of these grand palaces of nature's own fashioning, which must make the Grove a fashionable resort for future excursions."

Near Ebenezer, ten miles north of Springfield, are some interesting archæological relics, among them a large mound which has often been visited by tourists but never fully explored.

Drury College, which is named for Sam'l F. Drury, of Olivet, Mich., is a flourishing institution, and a decided acquisition to the city, both in point of educational facilities and on account of its handsome, substantial appearance. The National cemetery in which lie the remains of 1,500 Union soldiers, and which is handsomely ornamented with walks, flowers, etc.; also with huge cannon set on end, and with a very beautiful marble monument costing $6,000, the bequest of

Dr. Thos. Bailey, who died several years since, is also a source of pride to the citizens of Springfield, and an object of interest to visitors.

In the adjoining counties are many interesting natural curiosities, all within comparatively easy access from Springfield, such as the "Sunken Lake," of Webster county, about fifteen miles south of Marshfield. "This lake is on the summit of a hill and locked in by a wall of limestone about an hundred feet in height or, more properly, depth, for the top of the hill seems hollowed out and lined with this limestone basin whose walls stand perpendicularly, inclosing the lake solidly, except on the west side, where a gap occurs that one can descend with the aid of two 20 foot ladders. The crevices of the rocks surrounding the lake are filled with a substance resembling sperm, that burns like a candle, and in the basin are some old cedar logs, though no cedar grows nearer than eighty miles to this wierd region, whose name of Devil's Den suggests sorcery to the superstitious."

In Polk county, near the village of Orleans, and ten miles southwest of Bolivar, are the Wallula Chalybeate Springs, noted for their medicinal properties. They issue from the rock high up among the hills of the Sac River, into which they pour their waters. The surrounding country is exceedingly picturesque, and the springs are much visited by invalids and tourists.

In Christian county lead mining is carried on quite extensively while, iron and zine ores and tripoli have been found in abundance.

In Dallas county coal has been discovered extensively, also iron and lead, with indications of copper. In several portions of the county traces of ancient diggings are to be seen, but what these miners sought, and what they found, who they were, whence they came, whither they went, and when and how long they delved there are problems that no one has yet worked out. Near Greenfield are some Chalybeate springs, believed to contain valuable medicinal qualities.

In Dallas county lead is abundant, while iron, coal and building stone have been found different localities.

All of these attractions and sources of wealth are within about 25 miles of Springfield, and are more or less directly tributary to and dependent upon her for an outlet and a market. By extending proper facilities in the way of roads and purchasing capital she may easily remain as she is now, the gem of the Ozarks and the metropolis of the Southwest. C.

The commercial value of some forms of artificial ice is seriously lessened by its opacity or cloudiness, which gives rise to the impression of its impurity. This opacity is generally the result of the enclosure of innumerable minute air bubbles at the time of freezing. A simple method of preventing this defect consists in passing purposely a current of air through the water about the time of congelation, which in its ascent carries with it all the minute bubbles, and leaves the ice perfectly transparent.

MILITARY EDUCATION.

NATIONAL DEFENSE AND MILITARY EDUCATION.

BY CAPT. J. M. TROWBRIDGE, C. E., KANSAS CITY, MO.

It is proposed to occupy the attention of the Academy for a few minutes this evening with some thoughts on the subject of National Defense and Military Education. The subject is perhaps not without interest at the present moment, when several of the most enlightened nations of the world appear to be about to engage in a struggle for the fruits of a conquest achieved by one.

The principal interest of the subject to us lies in the question whether we are safe from outward assault. Americans are apt to put away from thought and sight the possibility that *they* are in any way liable to be brought into collision with any of the greater powers of the world. That we may yet be questioned at the sword's point, for the reason of our national existence, seems never to have entered the American mind as among human possibilities. We feel that our strength of numbers and resource are so vast that none but the strongest can assail us with any hope of advantage, and that those strong enough are so distant as to be prevented by the magnitude of the preparation necessary. Besides, having contiguity of territory with but one of the great powers, with whom happily all questions of boundary as well as all other known differences have been amicably adjusted, we feel that none can have motive for attacking us. Unfortunately for the peace of the world, where interest dictates motives are easily found, and it is only in perfect preparation that perfect immunity from aggression can be obtained. Under such circumstances neglect of due precaution is madness, and our blind, unreasoning assumption of security may yet work our ruin, if it causes us to continue to neglect preparation, when to be unprepared is to invite attack. It is not to what other nations will forbear that we must look for security. Safety lies only in ability to confront all possibilities any adversary can present. Fortunately for us the requirements to accomplish this much for ourselves are light, compared to those borne by the people of Europe. They should therefore be the more cheerfully sustained. If in accomplishing this, other great ends of national interest can be promoted, as we shall presently try to show, it will indeed be doubly criminal to neglect them.

A generation ago, the assumption that our strength and distance from any power able to cope with us afforded us sufficient protection was perhaps just. Then neither the men, the material or the transportation, for the purpose, could have been gathered by any European power except with occupation of so long a period of time and display of such active effort as would be certain both to challenge our attention and to afford us opportunity to prepare for its reception. Since then all the conditions of the problem have been changed. Then Europe

was forty days distant from our shores, now it is but ten. Then sea-going transportation consisted nearly altogether of sail vessels of comparatively small capacity, and to collect the number adequate to accommodate an army of invasion, strong enough to effect lodgemen tonour shores and protect itself during the three months or more required for reinforcements, would have been extremely difficult if not altogether impracticable. Now the English steam troop-transports actually carry one thousand men and officers with their entire field camp and garrison equipment and stores. It would require but one hundred such vessels to enable the embarkation of an army of one hundred thousand men. Probably one hundred such vessels are within the harbors of either of the great European powers any day.

During the same period of time, army organization has been brought to an amazing degree of perfection. A generation ago, the railway was in its infancy and the telegraph but just born. Then, to gather an army of one hundred thousand men occupied a period of time, which, rated at its speediest, had still to be measured by the slow paces of the postal rider, and the courier, distributing the order, and of the still slower movement of the diligence conveying soldiers to rendezvous, or regiments to frontiers. To-day all this time is comparatively annihilated. The telegraph reaches the remotest rendezvous as speedily as the nearest, and the conscript in the field, in the remotest part of the country, can be put in motion towards the rendezvous as soon as he at the doors of the capitol. It is asserted, with substantial reasons for belief, that were the German Emperor to issue an order to-day for the remotest regiment of the "first ban" or reserve army to report in Bremen in three days, that the third day would show the regiment at its post with full ranks, fully armed, equipped and supplied for immediate service at home or abroad. Of course, movement of the standing army would be still more prompt, but the reserve is here instanced because it shows to what perfection preparation may be carried for the collection of troops where no standing army is maintained.

The work actually accomplished by Germany during the first ten days of the Franco-German war of 1870 seemed magical, and leaves no doubt of her ability, if it became her purpose, to place an invading army of one hundred thousand disciplined troops on board transports in her harbors, in ten days, completely armed and supplied for service near or far. It is to be remembered that France commenced that war, yet, so superior was the German organization, that with all the advantages which the possession of secret hostile intent gave France, still Germany was first in force on the frontier, and at all times the superior. Indeed, whoever supposes that the improvements in military arts of the last thirty years have been confined to arms alone would be grossly deceived. While these by themselves have been sufficient to augment the destructive power of an army ten-fold and to change the whole system of tactics and fortification, they have yet scarcely kept pace with the rapid improvement in logistico, which is that branch of military science embracing all details pertaining to movement and supply of armies. At the present time everything is laid under contribution to perfect mil-

itary arts and materials. Every improvement in the arts and trades, and every invention, as soon as announced, is now sharply scanned by keen, discerning minds, to ascertain if it presents any single feature which can be applied with advantage to military purposes. It is but a few weeks since an American invented the telephone, and a knowledge of its wonderful capacities has scarcely yet become common property; yet it is already announced as an adopted instrument of the German military field service.

Reference is made to the Germans only, because, at the present time, they have carried military preparations to higher perfection than any other; but the other European powers are close and earnest students of her methods, and will never allow themselves to fall much behind in the rivalry for military supremacy. What Germany is in this respect to-day, a very few years will see all the other principal powers closely assimilating.

Military power is a product of three factors—numbers, preparation, resources. The want of either is fatal to effectiveness. Of the three, insufficiency of numbers is least injurious. This is contrary to common, current notion, but it is nevertheless true. The greater an undisciplined, ill-provided force, the more difficult to control, the more difficult to move, the more difficult to supply and the more easily made prey to panic. It is not the numbers subject to military duty, but the force ready, that constitutes a nation's strength. Hence, of the three factors, preparation is the most important. It is in preparation that our nation is weak. Preparation includes organization, discipline, mobility, supply. These give ability to smaller numbers to be always strongest at the point attacked, and thus gain victories. When exercising on the field of battle it is tactics, when practiced on the larger scale over a broad scope of country covered by distinct bodies of troops, it is strategy.

With the improvements in arms and the objects sought to be thereby obtained, viz., increased destructive power of the soldier, all are well acquainted; but the improvement in logistics, the supply and movement of armies, are not so well understood. Improvements in this branch seem to have been concentrated upon one paramount object, that of accumulating power for instantaneous, effective striking, to be able to crush a foe before he can prepare defense. It is the progress and improvements in these respects that have scattered the problem of invasion of the United States from Europe. The value of such power will be seen when we consider what is the object of human warfare. Wars are waged to compel the doing by one nation of that which another desires, usually claimed by the other to be right and just. The objects for which it is waged are unattained so long as power of resistance remains. Power of resistance consists in ability to collect men and munitions. Whenever a people are no longer able to gather men and material to make headway against their invaders they are subjugated. This is the reason why so small a force, comparatively, as an invading army, are able to subjugate the vast population of a nation. The American army of occupation in Mexico comprised less than one hundred thousand men, yet it held in subjugation a nation of eight millions. The German army in France comprised

only about eight hundred thousand men, yet were able to hold the highly military French nation of forty millions in complete subjugation. Neither of these peoples could accumulate at any point the men and material for resistance, before a stronger force could reach their depot, destroy the stores and disperse the force. In such circumstances a people have no alternative but submission.

Perhaps it will be thought by some that our navy should protect us from invasion by sea; but had we a navy respectable in tonnage and armament it would prove no reliance to prevent invasion. Scott says: "It is not necessary to combat an idea which all history controverts, that a large naval force will ever be able, by cruising in front of our extended coast, to prevent a hostile expedition from landing on our shores." The subject was long since thoroughly investigated and ably discussed in an exhaustive report to Congress by a board of American officers, whose conclusion concedes the impracticability of covering even a small extent of coast by cruising in front of it. Allison, the historian, finds in the facts of history "considerations calculated to weaken overwhelming confidence in naval superiority, and to demonstrate that the only base on which certain reliance can be placed even by an insular power, is a *well disciplined army* and the patriotism of its citizens. But patriotism avails little without discipline. Discipline is the soul of an army. Without it an assemblage of men in battle can never be more than a panic-stricken mob. Instances are not wanting in our own history to sustain this. Princeton, Cow Pens and Guilford Court House, during the Revolutionary war, and Bull Run, in the Civil war, amply sustain the declaration of Washington, that undisciplined forces are nothing more than a "*destructive, expensive, disorderly mob.*" The history of all modern warfare proves that it is preparation in peace gives victory in war. If the American people suppose that the facilities which our railways afford to concentrate large masses of undisciplined men in short periods of time, will supply the want of military training, they will find their answer in the quotations cited.

Meantime, while this progress is made by others, what are we doing? How are we preparing for an event which may be precipitated upon us at any moment? By reducing our diminutive army; by cutting down our navy; by doling the appropriations for our training schools at West Point and Annapolis; and by harassing both army and navy with neglect to pay and with constant threats of early extinguishment. A few years more of this kind of encouragement to our military profession, and of corresponding progress and improvement, among the military powers of Europe would leave us absolutely defenceless in case of a rupture with any of them. It was this disposition noticed by De Tocqueville, called forth the allusion to our danger in these mild reproofs: "That (in the United States) "the military career was little honored and badly followed in time of peace; that "the public disfavor bows down all military spirit; and that if such a people "were to undertake war, after a long peace, they would run much greater risk "than any other people of being beaten."

The course of Congress towards the army since the close of the civil war seems to be prompted by conviction either that a standing army is dangerous to

our liberties, or that it is an unnecessary burden. Possibly each idea has its several supporters. That an army of 20,000 can be very dangerous to the liberties of 40,000,000 needs only to be stated to show its absurdity. As regards usefulness, its honorable record may be triumphantly pointed to as sufficient answer.

Whatever the cause, it is certain that an unfriendly feeling towards our little army and its nursery, the Academy, is prevalent in Congress, and as the disposition of Congress is supposed to be a reflex of the popular opinion, it may be worth while to inquire somewhat briefly into its possible causes.

The feeling referred to has manifested itself mainly since the close of the civil war. That event left the army necessarily sectionalized in its *personnel*. Nearly all the officers of seceded States, obeying what they believed to be a paramount obligation of fealty to their native States, had gone into the Confederate army. Since the close of the war the return to the old condition has necessarily been slow. The Academy graduates from the Southern States are still low of rank, and the army is yet substantially a Northern army. With this constitution, it has been employed in the seceded States, to whom its sectional constitution renders it alien, as a garrison, to hold the territory; to conserve the peace, and to protect an enfranchised, servile people. In the Northern States its more recent employment has been in the suppression of the organized class rebellions, known as labor strikes; and in both North and South, it is constantly in use as a *posse* to suppress illicit distilling, an art but recently free to all. These offices are not such as admit of gaining any particular honor, nor should our little army be employed in them; in other countries they are relegated to the civil functionaries, supported, if need be, by a semi-military police.

Again, our army forms a distinct class. Its officers are the only servants of the people over whom the people have no control. Election day has no possible eventualities for them. They are under none of the necessities which originate demagogues, and have no occasion to seek popularity by arts which demean and deeds which degrade. They are apparently separated from the mass. They seem not to be of the people, nor as many would argue, for the people. While this seeming is far from the reality, it is none the less likely to continue until the people can be made to feel this supposed disposition is reversed, and the army of them, and with them, so that under all circumstances they can rely upon its sympathies. This forbids that it ever be allowed to become alien, either in rank or in file, or in any degree sectional. It must be among the people, of the people, and with the people, sharing in their aspirations, unswayed by their passions. Such an army can only be recruited from the youth of our own citizens, and from those of the better class if they can possibly be induced to enter. Inducements should be held out for these which will draw them into the ranks, and thus effectually Americanize the standing army which, fortunately for us, need never be a large one.

Our strength and our distance from Europe, whence only can danger menace us, enables us to satisfy the requirements of the problem of national defense with but little of the sacrifice which is the price of national existence there. The

American people would never submit in time of peace to the burdens of an establishment adequate to the requirements of a state of war. Our main reliance in any war must be, as in the past, upon citizen soldiery, but they must be better prepared than now. We are liable to drift into war at any time,—not so liable as are the powers of Europe,—but still liable, and that liability if we are to be an independent people, requires that we maintain so much of a military establishment as will keep the military arts and knowledge well known, and as will also enable us to put our volunteers promptly into the field, as far advanced in discipline as may be possible, fitly and skillfully officered, and thoroughly armed, equipped and supplied.

France, England and Germany are but ten days from us. Their forces are ready and are experienced. How would volunteers unused to drill or to discipline, poorly armed and above all, unskillfully officered, confront the veterans of Europe. It took McClellan one year "all quiet on the Potomac" to make an army of McDowell's mob. Fortunately the Confederates were in similar plight. Had either army possessed a veteran corps of twenty-five thousand men at Bull Run, the result had been different. With such a corps it is safe to say the Confederates would in ten days have held Washington, Baltimore, Philadelphia and perhaps New York, and compelled severance of the Union; or had such force been on the other side, Richmond and the Confederacy would have fallen in like period.

The situation in which our hundredth anniversary found the American people in respect of national defense was this: A nation of forty millions, with a seacoast of two thousand miles, everywhere accessible, substantially without a standing army and practically without a navy, but ten days distant from three of the strongest powers of earth, each "armed to the teeth" with the most improved arms and with organization and equipment perfected to the last degree; each able at twenty days notice to land one hundred thousand veterans on our shores, whom they could reinforce in twenty-five days more. These are the simple facts concisely stated. Now if we are to be an independent people, not living upon the forbearance of other nations, but able to resent insult or repel aggression, we must be able to meet the possibilities which these racts envelop. What is now our reliance? An army of volunteers to be raised in an emergency, and to be collected, organized and drilled by officers of a regular army, numbering at utmost perhaps one thousand disposable officers. How much time might our accommodating adversaries consistently be expected to wait for us to accomplish the work which took McClellan a year? That McClellan consumed a year was only because he had not enough trained officers to accomplish it earlier. *He had his officers to make as well as his soldiers.* Had there been at his command among the people any available supply of disciplined, educated officers, his work would have been done in one-fourth, or perhaps one-eighth of the year he occupied. Such a supply of disciplined, educated officers would require to be of sufficient magnitude to furnish complete official organization for an army of at least one hundred thousand men. This requirement would demand instantly the services of about five

thousand officers to fill the line and field offices and to put into action the equally important administrative duties pertaining to subsistence, transportation and equipment. Such a reserve of officers would leave our little regular army intact for immediate use, and it would then be able to fill its intended purpose of a nucleus on which to form the volunteer forces. Such a reserve, too, would serve to keep alive among the people the military spirit, which however deplored by visionary philanthropists, still is necessary for national defence and for national respect—unless indeed we should wish to become a nation like the Chinese. It was the wise Francis Lord Bacon who said "the principal point of greatness in any state "is to have a race of military men," and "that it consisteth also in the value and "military disposition of the people it heedeth." What was true then is equally true now, and so will remain till human nature changes.

Probably such a reserve of officers, with the partially drilled citizen soldiery now organized by the several states as National guards, will constitute the nearest approach the American people will ever tolerate to a standing army. Were the officers commanding these National Guards educated and disciplined, the Guards could not fail to be the better soldiers for such instruction, and the task of creating an army on the occurrence of hostilities would be already well advanced. A National Guard so originated and officered would be able to hold their own, in chosen positions, against perhaps equal numbers of veterans, and if the supply of officers were adequate, the aggregate of the National Guards of States, would furnish sufficient force ready at all times to take the field on the first call. An effort will be made to show how such a reserve of officers can be created without sensible increase of the annual national expense account, and without aggravating or intensifying the existing opposition to a standing army, or the army training school. Preparation to this extent is a defence which puts a different aspect upon the problem of attack upon the U. S., as viewed from abroad. It would not prevent a landing on our shores, but it would restrict offensive operations by a force so landed.

Whoever has looked upon the Corps of Cadets at West Point considerately, has perhaps asked himself or others the question: "What would they do were a foreign foe to assail them here?" No second thought gives hesitancy to the reply "they would fight desperately and defend their post to the last." No more effective garrison could possibly be gathered at that, or any post, than that constituted by the Corps of Cadets at West Point. If this be true of West Point, then why not convert every fortress on our sea-coast into a West Point, and every post on the frontier in a training or preparatory school for those?

To develop this idea more fully and at length, let us suppose that enlistments in the U. S. Army were hereafter to be confined exclusively to sons of American citizens, between eighteen and twenty-two years of age; that the term of enlistment should be for six years, unless sooner discharged; that the first two years should be spent in frontier posts learning the life and duties of the common soldier, becoming inured to its hardships, strengthening and developing their physical systems, and acquiring the beginnings of their academic education, in

preparation for the next step. The duties of the common soldier are now none too well learned at West Point. It is perhaps the only essential point in an American army officer's education not thoroughly taught, and this only because the time is too short. The Cadets now learn nothing of caring for their own horses, of cooking their own food, of gathering their own fuel and forage, pitching their own tents, or loading their own baggage on transportation wagons. They would make none the less efficient, kind and considerate officers for the possession of such knowledge practically acquired. They would know what soldiers should do, and while seeing that those thereafter under their command, performed their duties, they would be able to instruct them how best to care both for themselves and their animals, on which often so much depends. It is skill of this kind which maintains the efficiency of a military force in the field.

During these two years, whether in post or camp, they could acquire the studies of the present first year of West Point. This would give occupation to the officers, for the tedious hours, now too often given to idleness and dissipation. The terrible *ennui* of frontier garrison life, among the ignorant and vicious, would be changed to the delightful enjoyment of association with manly and intelligent youth preparing themselves physically and mentally for a life of usefulness among men, and especially for greatest usefulness in the hour of their country's greatest need.

From the frontier post the next three years should be passed in some of the sea-shore fortresses, when the course of study now occupying three at West Point would be acquired, or better, the course of those three years could be improved by additional studies not now, for the lack of time, embraced in the course. The last year could be passed at West Point in the same course now pursued there in fourth year. The material and appliances for such instruction now collected there, as well as its location, and its historical associations, time honored and inspiring, all conduce to render it peculiarly adapted to such purposes.

Such, in brief, are the general features of a plan to put the United States in perhaps as complete a state of preparation as may be done without incurring, in time of peace, the burdens of a war establishment. How this will accomplish that purpose an effort will now be made to show.

Keeping in mind the fact that the United States can never be wanting in men or material or defense, but that they are sadly deficient in preparation; and not in preparation only, but in the means of easy and early preparation, from lack of anything like a diffused and general military knowledge, among the people and more emphatically from lack of a sufficient supply of trained officers; we shall see at once that any scheme which spreads such knowledge among the people at large or provides the supply of skilled officers, to that extent at least overcomes that defect; and renders ready preparation possible—sufficiently possible perhaps for all purpose the United States may ever be called upon to meet.

In a cadet army, such as is now indicated, the same rules of discipline and academic requirement that now obtain at West Point should prevail everywhere, relaxed somewhat perhaps in point of academic requirement during the last two

years. Many would fail physically during those two years, as indeed do not a few now at West Point. Many more others would fail academically in each year of the course. If the numbers of these failures equaled the proportions of those at West Point and the entire army was limited, as now, to 25,000, there would be discharged each year about 5,200. There would also be graduated about 2,500, thus making an annual displacement from all causes about 7,700 and giving place for like number of new appointments. These displacements would be distributed about as follows from each class entering 7,700. Of original class there would be discharged

1st	year about	33%=2,541,	leaving	5,159
2d	" "	17%=1,309	"	3,850
3d	" "	9%= 693	"	3,157
4th	" "	5%= 385	"	2,772
5th	" "	3%= 231	"	2,541

who would be graduated with rare exceptions the next year.

A cadet army of 25,000 would give to each Congressional District in the United States a constant representation in its ranks amounting to near 70, and with the West Point ratio of discharges an annual appointment of about 20. The life, its openings, its association and its glittering possibilities could not fail to attract to it the very flower of the youth of the country. Recruiting officers would be no longer needed. Instead of poor vagabonds, waifs and social wrecks gathered from every clime but our own, we should behold an army of blooming, ambitious, American youth engaged in emulous strife for the prizes of an honorable calling—the most attractive known to man.

On completion of their academic course and the period of their enlistment, such graduates as attained to higher honors, should be commissioned in the army to extent of filling existing vacancies. All others should receive honorable discharge. Of course, but few would receive commissions; but those few would be of the foremost rank in attainments, and best qualified as instructors in peace, as leaders in war. All should be assigned for future service; their discharges certifying to their qualification for infantry, cavalry, artillery or engineer service respectively, as they had severally manifested most special adaptation.

Of the undergraduates discharged—all whose dismissals were not brought about by breach of discipline or dishonorable conduct should receive honorable discharge and to every honorable discharge, whether of graduate or undergraduate, there should be affixed a rating or rank, as provision for future military service in case of war, to graduates—say as regimental field officers, undergraduates of four years' service as captains, those of two and three years' as lieutenants, and those of less as non-commissioned officers.

Of the 2,500 graduates, not more than 75 or perhaps 100 would, on the average, receive commissions. This is a larger number than the average of the annual graduations at present, but it is presumed that for a cadet army of the kind indicated, a larger proportion of officers would be required for instructors. There would then be 2,400 graduates returned annually to civil life and its pursuits, prepared to respond to their Country's call whenever services she had qualified them

to render should be needed. In addition to these, there could be annually returned to the same pursuits, 5,200 more of undergraduates, of whom about half, or 2,500, would have had a year or more of military experience, and who would, therefore, be more or less qualified to render valuable service in the instruction and command of raw volunteers.

In ten years' time there would thus be discharged into civil life, 25,000 graduates and about an equal number of certified undergraduates. In the same period of time probably half of these would become *hors du combat.* Some would be no longer living, some would be physically disabled, through the various ills and accidents of life, some would be abroad and some would be occupying positions of trust and honor, such as judgeships, legislative seats, or perhaps, executive chairs, where the service they could render their country in case of war would be greater than if in the field. Perhaps one-half could at all times be relied upon to respond to the first call to arms, and spring to the defense of their country. These would amount to about 25,000 educated, disciplined officers, accustomed to military life. This would afford ample skilled leadership for a force of 500,000 men. If less force were needed they would be only the sooner organized and disciplined by the larger proportion of veterans distributed among them.

Coming from among the people, they would bring with them the young men of the communities in which they would be living, who would be well acquainted with them and to whom their military education and experience would be well known, and who would thus feel confidence in their leadership and ability to command. Many of these graduates would probably be found employed, when the call came, as teachers in the schools and colleges of the country, giving instruction in military drill as well as in the sciences. Their pupils accustomed to look to them for leadership would feel the call of patriotism with that irresistible flood which comes from the impetuosity of youth, encouraged in its noblest impulses by the example and association of a respected and honored teacher. Again many would naturally be found, by choice of their fellow citizens or perhaps by State legislation to be commanders of the several state military organizations. In the principal towns such commands would naturally gravitate to their possession, by the rivalries of local military companies among themselves, seeking experienced leaders. Their soldiers would naturally follow their commanders into the field and these two sources, taking the aggregate of our National Guards and Colleges, would probably furnish the first quota, already more than half disciplined, ever likely to be required for any emergency which may fall upon the United States from foreign sources.

With a military system so arranged, our visible army, while filling all the functions of a present army, would still be only the training school of the real army which would be among the people. A place upon its rolls would be comparatively easy of attainment and the feeling of caste as well as all approaches of danger to our liberties would then naturally cease, for the American Army would then be an army of the people, with the people and for the people, understanding their liberties and knowing how to maintain them.

METEOROLOGY.

THE RICHMOND (MO.) CYCLONE.

COMPILED BY THE EDITOR.

On Saturday, June 1st, one of the most violent, destructive and fatal tornadoes ever experienced in this country, passed over the central portion of Ray county, about thirty-five miles east of this city, striking the town of Richmond, destroying over one hundred buildings, killing outright thirteen persons, and more or less seriously wounding more than seventy others.

The Richmond *Conservator* extra says: "A cyclone struck our city yesterday, at 4:05 p. m., and in the short space of five minutes totally destroyed one-third of the place, its path being nearly three squares wide and extending for over a mile in the city limits. It originated on the farm of Wm. H. Fitch, three and a half miles south of the city, and prostrated fences and crops in its path, and injured the premises of Jno. C. Laforge, where it lifted and struck again at Col. Warrenstaff's, destroying his stables, fences, etc.; then lifted again, passing over the residences of Captain J. L. Farris and James Hughes, and struck with full force the residence of William Jackson, and then continued with unabated fury, leveling everything in its path.

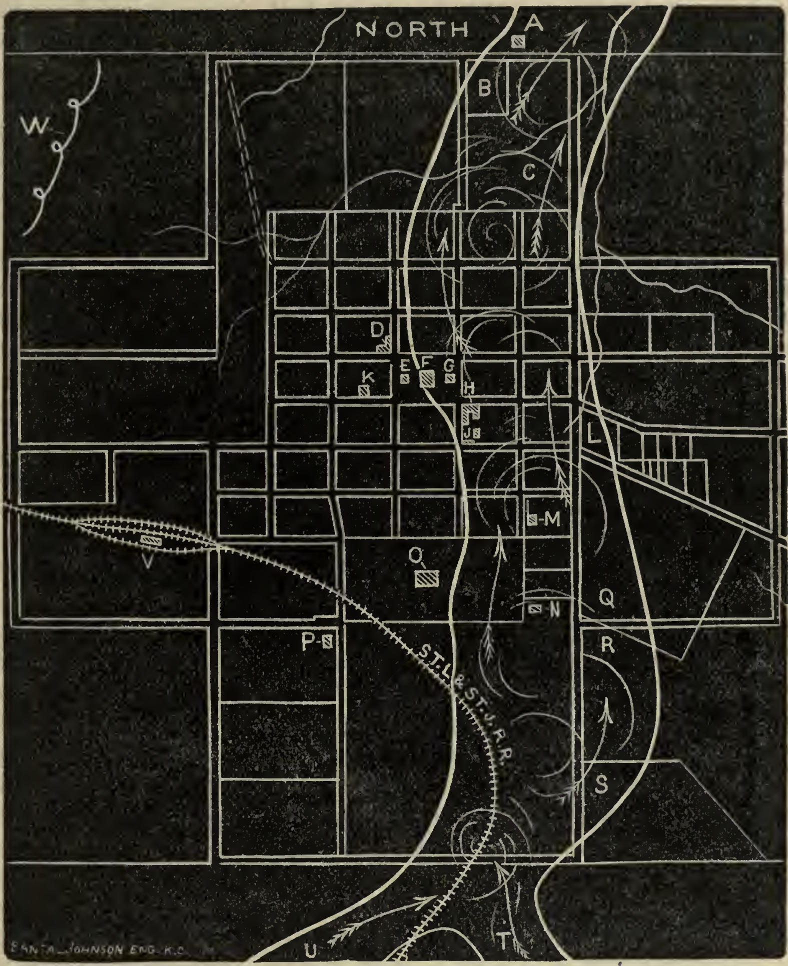
We noticed its approach from our office balcony, our attention being attracted by its peculiar shape, that of a funnel, the small end down, the color of steam. At times it would break, emitting volumes of what appeared to be black smoke, then gather together again and assume its funnel-like proportions, the wind all the while being attracted toward it. It came on slowly — not much faster than a man could walk — destroying everything by its infernal whirl, producing a sound like the roar of Niagara. Where it struck with its most terrific force, it peeled off the bark of trees, leveled the grass and shrubbery as if it had been rolled by a large roller, or been swept by a torrent. Trees and outhouses were carried bodily away, and the debris of the city fell miles from the city."

The Richmond *Chronicle* extra says: "The direction of the cyclone through the town was from south to north, direct, with a tendency to move west. Its motion was rotary; its appearance funnel-shaped, resembling a waterspout. Not a drop of water fell during its passage through town. There were ascending and descending currents. In its pathway the air was filled with debris. Its pathway has the appearance of having been deluged with muddy water, owing to the fact that a heavy rain preceded the cyclone a few minutes and the ground was wet, and the mud was smeared over everything. The time of its passage through town, to the best of our recollection, was three minutes. The cyclone swept over that part of town in which were situated most of our mechanical shops."

The Kansas City *Times* special dispatch gives the following additional items: "The storm struck the city a short distance south of the Presbyterian church, which it laid in ruins, carrying the immense bell into the middle of the street, and portions of the roof several hundred yards. One piece of timber on which was inscribed "Praise the Lord," was carried two hundred yards. The width of the storm's path was about two hundred and fifty yards, in which not a single house is standing. One house adjoining the Presbyterian church was taken off its foundation and carried a hundred feet where it was dropped down and pulverized. A large tree in front of a house situated on the extreme southern limits where the storm struck, was taken up by the roots, carried over a portion of the house and dropped, while the house remained untouched. The storm traveled toward the north, and the current was against the hands of a watch, as is the case with all cyclones north of the equator. The direction of the current was evident from the twist of the trees, and the manner in which the bark was peeled. The cyclone traveled about as fast as a man could walk, but it was not regular in its progress, sometimes going more rapidly than at others. It was formed in the shape of a funnel, and moved like a spinning top. At times it would become surcharged and burst forth, scattering the debris in all directions. Then it would gather again for a new onset, and at a short distance would strike again with indescribable fury. As above stated, there are no houses standing intact in the track of the storm. In most cases it went down into the foundations and took up the sills on which buildings rested, scattering them no one knows where. Scarcely a single piece of fence is left to mark the boundary lines between different properties.

The Old Cemetery, where the cyclone made its last stand before its retreat, gives perhaps the best evidence of the power and fury of this unparalleled storm. This is an old locust grove in the extreme north part of the town. There is not a tombstone but is leveled, and many of them broken into many pieces. Many of these graves can never be identified again. The trees have been twisted and whipped until there is not a leaf on them, and nearly all of them have been leveled to the ground. One tall locust stands erect and alone, but its bark has been peeled off from top to root as perfectly as a boy could peel a paw-paw for a whistle. This process of twisting off the bark gives a slight conception of the immense power of the cyclone. So great was the power of the wind that James Duncan was blown over three houses and instantly killed."

To the Kansas City *Journal*, which dispatched a messenger to the scene of the storm, we are indebted for the following interesting particulars: "We learn from Mr. Casey, deputy postmaster at Missouri City, that the cyclone gathered near that place between two and three o'clock. The steamer Fanny Lewis had left the landing, and was about a mile and a half down the river, when she was entirely hidden from view by a dense, muddy looking, funnel shaped cloud which passed near her and close to the water. This cloud then raised and passed to the right of the town, and at the same time another cloud of a like description passed to the left, the distance between the two being estimated at about two



The trail of the cyclone is indicated by arrows and circles, and its boundaries by the white lines east and west: A—Direction of Cyclone on leaving the city; B—Old Cemetery; C—O. A. McFarlany, D Hudgins' house; E—Office in court house yard; F—Court house; G—Building in court house yard; A—Brick block on east of square; J—Shaw House and buildings; K—M. E. Church; L—Major R. Sliner; M—Baptist Church; N—Presbyterian Church; O—College; P—Kelsey's addition; R—Joseph J. Hughes; S. J. Wetmer's heirs; T and U the point at which the two wings of the Cyclone united; W—Manner in which the Cyclone moved on its eastern edge.

miles. As they swept in a northeast direction they made a noise resembling the running of a heavy freight train, and attracted general attention. Far off in the distance they appeared to unite in one immense cloud, and descend toward the earth. The day had been intensely sultry, and when the clouds were passing Missouri City, great drops of rain were falling; and such had been the character of the weather throughout the day.

When it reached Richmond Mr. David Whitmer was standing in the back door of his stable, and says that two dense, black, funnel-shaped clouds

appeared to unite in one, and to come onward, with the small end of the funnel down. This appeared to act as a sucker for the vacuum of the funnel, and would draw all objects in its path upward with a sifting motion and then scatter them broadcast over the ground. It would draw a house up from the earth, and shake it back and forth like the vibrating sieve in a fanning mill, carrying the lighter portions up into the funnel, and letting the heavier ones fall. It moved slowly—slow enough some say, for a man to have escaped from its track. It appeared that whenever the vacuum in the funnel became filled or overcharged, the cloud would burst, and then buildings would be swept clear to their foundations, and the ground swept as clean as if by a broom. Then it would belch forth its contents of debris, timbers, mud, water, looking, as eye witnesses report, like a building on fire, surcharged with flame and smoke. This characteristic appears to account for the almost wonderful preservation of lives and property in some instances, while all around was scattered dire destruction."

It entered the city first on the track of the cyclone of eight years ago, and came far enough down to pay its respects to the *Conservator* printing office of Mr. Jacob Childs, from which it lifted a portion of the roof; it then hung in that vicinity for several seconds, when it took the back track, paying its respects to the roof of the saving's bank, and departed again to the south, where it united with the cloud as seen by Mr. Whetmore. After striking the residence of William Jackson, on the hill in the southern suburbs, which it destroyed, it mowed a swath three hundred yards wide to the extreme northern limits of the city, clearing from the ground every vestige of improvement, leveling the strongest buildings to their foundations, and carrying the composing materials of their construction in its deadly grasp far away. In some instances it went beneath the foundations of strong two and three story buildings and dug out heavy sills, 18 inches square and 16 feet long, and carried them beyond human knowledge. The wonder is now in looking over the ground, not that so many were killed and injured, but that any escaped. War, in all its terror, never wrought destruction such as is here visible on every hand. The human mind is too weak to grasp the picture, much less to paint it in words. Great trees were torn up by the roots and hurled rods away, others stripped of every leaf and twisted off near the ground, (and in every instance against the sun, or from the west to the east.) From the ground to the topmost twig others are entirely stripped of bark and branch—shaved as clean as a whistle.

In the old cemetery there probably is to be seen the most impressive evidence of the force and power of the cyclone. It occupies about an acre and a half of ground, was thickly studded with stones and monuments, and shaded by a heavy growth of locust trees, many of them eighteen inches through. Four-fifths of those trees were twisted off eight or ten feet from the ground, or even uprooted, and the few that remain standing have been stripped of bark from the roots to the topmost twig. Every stone and monument is overthrown or broken off and the ground is pulverized and grass scorched as if burnt by a cloud of fire.

All day Monday and Tuesday the owners of private residences were in many

instances engaged in searching in the vicinity of their once homes for household relics, only too rarely found. In a few cases the house had been swept from the sills, leaving the boards of the ground floor in place covered by the carpets, and these were being removed. In one house there remained a piano, in another a bureau, each only slightly injured, the latter being of special interest in having preserved the life of a mother and child who were prostrated in front of it when the house was swept away, and a mass of falling timbers that were dashed downward found support in its unyielding strength, and the mother and child protection at its base, while a few feet away another woman, an inmate of the same room was crushed to death. The post office was entirely swept away, not a plank of it being left in place. The mails were scattered to the winds, and some have since been returned from a distance of twelve miles. The stamps, moneys, books and accounts were all lost.

The remarkable features of the visit of this disaster are many. Among the first to observe it was Mr. Jacob Childs, editor of the *Conservator*, from the balcony of his office. Eight or nine years elapsed since he last saw one of these engines of destruction whirling on its course, and he had felt, as well as seen, its effects through the utter destruction of the upper story of his office. He at once ordered the office closed and started for home, and had gone but a few rods when the roof of the establishment he had left was drawn up into the air, forcing from him the exclamation of "The *Conservator* is gone this time!" Here it moved in mid air for a few seconds, keeping up a violent rotary motion, and emitting a sound which he describes to have been "like the roar of Niagara," until, as if drawn by some attractive force, it retraced its path to the southern limits of the city, and over the railroad track formed a junction with a similar atmospheric or electric machine, and swept on in its broad and wide-spread course of destruction as laid down in the diagram. On the east the line of demarcation between the property destroyed and the property left intact is almost as unbroken as the swath cut by a mowing machine, while on the west the line of total destruction is broken, not unlike the teeth of a lightning saw blade, with a loop formed at the point of the teeth, as seen in diagram at W; between these teeth trees, dwellings and all manner of objects would be left unscathed, while all around, and partly to the rear of them, every object would be wiped away. This is seen by the large two-story frame building on the hill south of town. The dwellings opposite on the west are gone to their foundations, and also on the north. The smoke house and out building to the south were leveled to the ground, and a large tree growing on the west, and only a few feet distant, at least eighteen inches in diameter, was parted from the roots about eight inches below the ground and lifted up and carried over the porch and deposited to the east, and not to exceed thirty feet from the place where it was growing. The sod at its roots was undisturbed; it was pulled as a tooth would be pulled by a turnkey and broken off in the jaw. This house with the shubbery surrounding it was left undisturbed save the loss of its chimneys and a few shingles. Not even the glass in its windows were broken. A few rods further down the street a large frame cottage was lifted from

its foundations, and carried over the fences and dashed fifty feet away into the street a heap of scattered ruins. The fences were undisturbed, the roses are blooming in the yard as before, but the soil under the house is as hard and barren as a parade ground. Nothing in the track of this monster was simply toppled over. Everything was lifted up by the neck of the funnel and carried into the body of the cyclone, to be afterward dropped, except at those times when it appeared to discharge itself with an outward explosive force, and then swept onward with renewed strength. Its looped and jagged edge on the west is instanced all along its course. As above in cutting all around the house over the porch of which the tree was carried; by the frame house adjoining the Presbyterian church, which was moved from it foundation a few feet but left standing, while the massive brick structure adjoining it, and within a few feet, was leveled to its foundations; by the court house, from which a portion of the roof was taken and all the chimneys cleaned, the towering belfry being left intact. Again, by the entire escape of the fine two-story residence north of the post office, which escaped almost without injury, either to itself or the beautiful grounds in which it is located, and lastly beyond the "old cemetery," where it crossed the road and went around Roterside's place, and again returned to the road a few yards beyond. It followed the line of shops and the slope of the hill that runs towards the valley east of Thornton avenue, only crossing that street with its jagged edges; and in no instance going fifty yards beyond to work excessive damage, and the citizens believe it was attracted along that line by the electric elements which were there contained in larger quantities than in any other part of the city. Every one of these establishments was leveled with the ground. In support of this electric theory is the fact that out of the wreck of the wagon shops and from the ruins of many carriages and buggies throughout the city the country is strewn with fragments of vehicles, and parts of them are found miles away. In most instances the iron work is broken or twisted, the spokes have been stripped from the wheels and the tires bursted asunder. Sewing machines were invariably broken into fragments, and agricultural implements appeared to have had special attractions for cyclonic fellowship. A gentleman who was picked up and whirled in the cyclone, says he was at work in the yard, and that his attention was first attracted by the noise made by the approaching cloud. He looked toward it and saw it coming with a roaring noise that was almost deafening. He had time to run from it, but could not; he stood petrified and in speechless astonishment. It lifted building after building into the air, and appeared to throw the fragments aside in a sportive, playful manner, but with an awful grandeur that appalled him to the heart. Soon he was caught in its grasp, raised, from the ground and whirled around like a spindle in a loom, and finally dropped or hurled against a tree, over a hundred yards distant, to which he clung with the tenacity of despair until several minutes after the danger had passed. He was bruised all over, and covered from head to foot with a coating of drab-colored mud, the same as that which has painted every object in its track.

There were times in which the monster was as gentle as a lamb. In one of

the streets it picked up a little colored boy five or six years old, carried him a hundred or more yards, and then gently deposited him in the midst of a mud puddle, and the surprised youth was extracted finally without a scratch. It carried away every article of furniture of a room in the Shaw house after taking off the roof, and left hanging on the walls a lady's sundown. We have already written that it swept away dwellings and left the shrubs and flowers at the doorsides to bloom as before. It was a fear and a wonder moving over the face of the earth, and man can test his own weakness by its strength.

In minor incidents the passage of the cyclone was rich. Into a tree near the old cemetery a piece of glass was driven nearly four inches. It was an eight by ten sheet, and had struck at the corner. The bell of the Presbyterian church, nearly a ton in weight, was whirled thirty feet from the church foundation and cast unbroken to the street, and a portion of an arched altar or window ornament that had graced the inside of the edifice, and on which the name of the Lord was painted in gilt letters, was laid down beyond the Shaw House. A rabbit was driven head first into an old stump and so tightly wedged that it could not be pulled out, and feathers out of innumerable feather beds had been driven quill first into the bark of trees, clothing the monarchs of the forest with down, after stripping them of leaves.

Beyond Richmond, that is, after mowing a swath from the extreme southern limit of the northern one, it lifted itself from the ground and made a jump of two miles, coming down at the farm of Mr. Thomas Bohannan, near the bridge over Crooked river. The dwelling and all improvements were cleaned up to their foundations. Mr. Bohannan and wife, who are among the oldest settlers of Ray county, having lived on their farm almost fifty years, were both severely injured. The cyclone then paid its respects to the iron bridge, which it doubled up and twisted out of all shape, and entailed a loss on the citizens of Ray county of about three thousand dollars. It then called at the residence of Mr. Hughes, on the Wasson place, and destroyed the farm house, barns and stock. Continuing on its course it took in the farm and vineyard of a German named Vermilious, and thence to the widow Johnson's, wrecking everything in its course, until it reached Hiram Settle's place, a point about two miles beyond, on the main prong of Crooked river, in the mean time whirling through the heavy white burr oak timber of the wooded bottoms, prostrating the monarchs of the forest to the ground, or twisting them off in its inexorable grasp. It passed over the little village of Molton, in the eastern portion of Ray county, and came down at Highsinger's, a point twelve miles beyond Settle's, and on the edge of Ray and Carroll counties, the house being divided in its taxes by the county lines. It no longer exists. For a few miles in Carroll county it appears to have repeated its work in Ray, and also appears to have changed its course from a northeast to a southeast direction, passing in the vicinity of Carrollton near enough, it is said, to be heard and seen, but only dropping its compliments in the shape of immense hailstones, containing at their center mud and grass. The cyclone was plainly

seen at Norborne, and for a few moments occasioned great consternation among her citizens."

This closes the account and description of the cyclone, to which we append a few extracts from the editorial comments of Col. R. T. Van Horn, who has given much attention to meteorology, and whose recent article on the "Atmosphere and its phenomena," read before the Kansas City Academy of Science, published in the *Review* for February, 1878, attracted so much notice:

"The tornado has become a fearful thing, and our neighbors of Richmond, Missouri, are to-day mourning over a calamity that will become a memory in its history for all time. Short and terrible was the work. Eight minutes is the time stated, but minutes in such cases are ages. We do not know that a knowledge of the law of tornadoes would be of any practical benefit, for unless that knowledge led to methods to dissipate them, there would be no protection. We believe they are of more frequent occurrence in given localities than in others. Of course this is true as between the tropics and the temperate zones, but we believe it to be so in the latter. There is a district of country traversing Alabama and Georgia that is noted for the frequency of these storms, and in the country north of the Ohio river there is a belt in which they occur every year. It is so, measurably, at least, of Southwestern Kansas and across a portion of Nebraska. The recent terrible tornado of Wisconsin was in a portion of country that has been frequently visited—only last year there was one of almost equal power with this. Then there is a frequency of them in a strip of country extending from Alton above St. Louis south of that city, that cannot be ascribed to mere accident. On the contrary there are districts of country between these, where tornadoes have never been known to occur. These facts are sufficient as a basis for investigation, as they cannot be merely accidental.

In former years we have referred to this subject at length, so that it is not necessary to repeat the arguments and facts now. What little attention we have been able to give to the phenomena, and where we have been able to trace the lines of a tornado for a long distance, we have found them in every case to correspond in their movement to lines of mean temperature as laid down on the isothermal maps. But they are not like an ordinary storm, continuous, but rise and fall like a balloon, and it is only when they touch the earth that they leave any evidence of their passage. Thus the tornado that devastated Richmond may have bounded from the ground and spent itself in the upper air, or it may have come down again in Illinois to be regarded as a separate one entirely. But sometimes they travel so nearly on a plane as to be traced for hundreds of miles. In all such cases that we have investigated, the fact that they followed lines of mean temperature, or were coincident with them, remains.

"The reporter of the *Journal* yesterday gave the only full and satisfactory account of the Richmond disaster in the matter of casualties that has been published. This morning he gives a number of incidents and facts which bear on the theory of these mysterious phenomena, and which seem to bear against the wind theory as the destructive element. The other theory is electricity—or in

other words that the objects on the surface are lifted by electric force into the cloud, instead of being blown by a moving wind. The cloud is like the pole of a battery positively charged, and the earth a pole negatively charged. Now place a bar of iron or any conducting substance across and touching the two poles, and the equilibrium is restored. The theory in this case is, that the houses, trees and movable objects taken up are the conducting media, and as soon as the equilibrium is restored they are dropped to the earth again.

"In the incidents related by our reporter, this theory seems to be generally and as a rule sustained. The objects taken up are not blown in advance of the storm, but are invariably shot upward into the interior of the funnel-shaped cloud and dropped from the more expanded mass above. If it was wind they could not be dropped. Then we find a roof lifted and set to one side and the building below the roof uninjured. This cannot be from even wind moving in a circle without lifting power at the same time. Again, trees are sometimes torn up by roots and carried up and let down. A wind with only forward or horizontal force would have prostrated the tree simply. In other instances trees are left standing but stripped of bark entirely even to the twigs, which are otherwise intact. This cannot be the effect of wind in any of its movements or in any direction of its force—it must be another force. And as electricity must pervade the body of the tree acting outwardly, the denuding of the bark is in harmony with this action. And finally we have instances where it went below the surface down to the foundations, and tore from their beds masses of timber sills eighteen inches square and sixteen feet long. This could not be mere wind moving horizontally. We next have the bounding movement of the cloud, coming to the earth, taking up a mass of material, dropping it, and rising into the air again, and coming down at other points. Is not this the result of differing states of equilibrium, exhausting its power, and when discharged of it, accumulating more from the surrounding conditions? It touched as many as six places in Ray and Carroll, bounding from two to four miles at a time.

It was also attended by a great development of heat, the grass and trees having the appearance of being scorched, and the cloud emitting volumes like black smoke. We have no direct testimony in this case as to actual flame, although this is not an uncommon phenomenon. This is of course electrical, and strongly supports the theory we have been considering. The roaring noise could not be the result of motion alone, for it was louder than even thunder, and it was moving at times no faster than a man could walk. This must have come from intense internal action.

Finally we have its motion in the direction opposite to that of the hands of a watch. The movement seems to have been on a straight line on the southern edge of the cyclone—that is the track of destruction makes a straight line on the southern edge of the storm track, while on the northern edge it is uneven. For example, a house on the north edge is totally destroyed while another in a direct line with it is untouched; then another swept clean and beyond it a house unscathed. We cannot describe it better than to lay a cord down on the floor with loops in it

at intervals. The loops represent the points of destruction, and the intervals where no damage was done. This is one of the most remarkable instances we have ever known in the history of the cyclone, and we have no doubt but this Richmond tornado will, from its destructive power, the slowness of its movement and the length of time it was observed, become one of the most noted for its scientific value.

A CHINESE TORNADO.

Correspondence of the Hong Kong *Daily Press*, dated Canton, April 14, gives the following particulars of the terrible tornado which visited Canton and its suburbs on the 11th of April: Passing ever the Shameen settlement the storm crossed the canal to the city, carrying away in its course the balustrading of the East bridge. A native police station opposite was also completely destroyed. The storm leveled all the houses in its course, making a clean sweep of everything for a width of about six hundred feet. The mortality has been variously estimated at from five to ten thousand, and probably the latter number is nearer the mark. Nine thousand houses (speaking in round numbers) are known to have been destroyed, and although many of the inmates had notice of the impending disaster by hearing the noise caused by other houses falling, and made their escape, there were other cases in which great numbers of people were killed by the fall of a single house. For instance, there was an eating-house in which fifty-two assistants were engaged. In this house there were at the time over one hundred people taking refreshments, and none, either assistants or or guests, are known to have escaped. In another case twenty-four persons were killed by the destruction of a family house. There was also great destruction of boats and life on water. Allowing, therefore, for there being no one in many of the houses at the time of their fall, and, on the other hand, allowing for there being great numbers in some of those that fell, it is probably below the average to estimate the loss of life at one to each house that fell, and a thousand lives on the water. In most of the houses blown down fire was probably beirg used, either for cooking or other purposes, and kerosene is now so universally burned that it would have been no cause for surprise had the conflagrations been much more extensive than they were. As to the clearing away of the dead bodies, the Chinese authorities seem to have acted with commendable promptitude. Almost immediately after the catastrophe orders for four thousand coffins were issued by the Ol Yuk Tong hospital, and up to the time the steamer left yesterday afternoon three thousand bodies had been recovered from the ruins and buried without delay. The work of clearing away the debris was proceeding rapidly, but the stench in some places was unmistakable evidence that there were dead bodies still to be extricated. The violence of the wind for the few minutes it lasted was as great as that of the severest typhoon. Granite blocks were lifted from their places and hurled a considerable distance; thick trees snapped in twain like twigs; roofs were lifted bodily, and boats carried far on to the shore. In

one case a small boat was actually blown on to the roof of a house in the Tenth ward. A row of houses—all brothels but one, forming one side of a short line in the city—were the scene of one notable catastrophe. The other side of the lane is formed by the side wall of the Nam Cheong temple, which is some thirty feet high. This wall gave way to the force of the tornado and fell crushing in upon the opposite houses, the inmates of which, about one hundred in number, were all killed, most of them being crushed to death, and the remainder suffocated. There was no means of exit at the back, and no one attempted to dig the bodies out of the ruins. The narrow creek is still partially choked up with debris, consisting of broken boats and other wreckage, in which are numbers of dead bodies. In too many instances whole families have been crushed to death in one boat. The supply of coffins is nearly exhausted, and the undertakers are now, I am told, charging double price. The villages of Pah Hin Hock and Pah Hock Tang, two or three miles to the north, outside the walls, were caught in the storm and suffered great damage, many dwelling houses and other buildings being destroyed and numbers of lives lost. The village across the water opposite the Shameen came in for its share of the disaster also, being partially destroyed. I hear that, though the whirlwind did not effect so much damage at Fatshan as in this port, it has made severe havoc. It is stated by Chinese who have come from there that no less than two hundred houses have been laid prostrate, while about half the boats in the river there have been wrecked. The loss of life has been put down at several hundred. A passage boat coming from Fatshan to this city was, when a short distance off, caught in the tornado and instantly capsized. About seventy of the passengers were drowned. The tornado, it appears, came from a direction quite contrary to that in which the cloud had been traveling immediately preceding it.

MINERALOGY.

MR. BRAGGE'S COLLECTION OF PRECIOUS STONES.

There are few private individuals who have made more rare collections than Mr. Wm. Bragge, F.S.A., of Sheffield. His magnificent collections of pipes, snuff boxes, &c., shown at one of the London International Annual Exhibitions at South Kensington, must have struck most visitors. At a recent annual conversazione of the Birmingham and Midland Institute, he generously lent another of his splendid collections—that of agates, silicious, and precious stones. The glass cases were nearly all filled by the wondrous specimens of natural beauty and artistic work, which are scarcely surpassed even by the Imperial Museum at St. Petersbug. The beautiful examples shown were not only interesting to the mineralogist, but especially so as rare specimens of the lapidary's art, and consequently interesting to large numbers of art-workers of Birmingham. It would

be difficult to describe the rich and rare beauties of these articles, nearly every one of which is a marvel of the eccentric and exquisite beauty of natural productions, originally hidden in a rude crust, and only displayed in their true glory when sections have been made, and the latent inner beauties disclosed. The cases included a wonderful variety of all sorts of silicious stones, and a large number of the rare and valuable precious stones, of every conceivable color and every variety of form. On the left, on entering the Museum, a number of examples of silicious wood were shown, in sections and boxes, in all of which the silica has replaced all the varied outlines of the wood in the most graceful and fantastic forms. All these specimens are so rare in beauty and so delicate in structure that it is difficult to believe that they are only subtle works of nature in the secret places of the earth. Next came superb specimens of jade—one of the richest but most intractable materials ever subjected to artistic treatment. In many jade ornaments years of labor have been devoted to the mere mechanical work of cutting away the surface and leaving the strange forms of oriental taste. Jade is not merely white, as is generally supposed, but is here to be seen green, clouded and opaque. One of the *plaques* is a marvel of art, a double pattern, one under the other, being carved with infinite patience and the rarest taste. A little bottle, with a delicate chain and stopper, carved from a single piece of white jade, semi-transparent, was a surprising piece of workmanship, and another bottle had a lapis-lazuli stopper executed skillfully. The moss-agates were very interesting, the delicate outlines of the fern-like stems and leaves being imbedded in a transparent body, causing an exceedingly beautiful effect. The Mocha stones and the Egyptian jaspers claim notice; although mere baked clay, stained with iron, they were rich in color, and one example of red jasper, and some others, as boxes and pipes, must be wonderfully rich and rare. Three trays of bloodstones arrest attention, and snuff-bottles, with carnelian, green jade, and tourmaline stoppers, and a curious snuff-rasp. Next came a mass of aventurines; some slabs and sections of the curious catseye stones, rough and polished; and a double case of thirty oval stones (the central stones of a fine ring, changeable every day for a month), some being inlaid with rubies gave a magnificent illustration of Oriental art and taste. There where trays of opals, some being mounted as a sort of buckle for a mandarin's belt; also superb specimens of labradorite, the full iridescent beauties of which, magnificent in color and dazzling in brilliance, can scarcely be appreciated by any artificial light. The pink tourmalines and chrysoprases, were wonderfully varied in color and often exquisite in form. One large oval slab of serpentine, some ten inches by six inches, looked like a rich dark-green mass, but it is really semi-transparent, and has a strange richness of color from the number of garnets which are buried in its surface. The numerous lapis-lazuli stones of the collection were rich in the extreme, and a large spill-jar of huge size and fantastic form, rich in dark-green color, and quaintly carved, at once arrested attention as a marvel of material and art. Next to this was a great block of malachite, of massive and quaint form, and superb in color. Then a tray of fine sapphires, nine in number, and of great variety of color, brilliant in

tone, and splendidly cut. Tourmalines, moonstones, and corundums fill the next few trays; and then a fine selection of turquoises fascinated the eyes, being ornamented with Chinese and Persian art, tastefully outlined, and inlaid with lines of gold, and others shaped into bottles, of beautiful and graceful forms. The case of emeralds caught the eye at once, and showed many wonderfully varied in shade of color. The emeralds in the rough were remarkably interesting, and the amethysts specially superb in color. Among the rubies, sapphires, and opals, one magnificient sapphire, being 2½ in. by 1¾ in., excited great interest and admiration. Topazes are usually believed to be only yellow, but here there were specimens of many shades of color, and one was particularly interesting from its having an Egyptian hieroglyphic *intaglio*, the "cartouche" or signature being indentical with that carved on Cleopatra's Needle. Three enormous examples of Brazilian yellow topazes deserve special attention from their size and color; while five pink topazes, five catseyes, two obsidians, three aventurines, four turquoises, with some labradorites and chrysoprases were far too fascinating to be passed without a long admiring pause. The next case contained some remarkably splendid examples of old Roman mosaics and of modern Florentine Pietra Dura, and Viennese "incrustation work," an embossing of precious stones on an equally precious base. In this case, not only fine examples of the best Roman mosaics were displayed, but one of the smaller slabs, a view of a bridge and castle, looked more like a miniature than a mosaic, so microscopic were the stones and colors of which it is composed. The cameos in the same case deserve special mention, that of the late Prince Consort being in very high relief, while the two large oval shell-cameos are superb samples of the engraver's art. Passing many of the minor beauties, the attention was next riveted by some fine carnelians, of all shades of color, from pale gray to deep blue and red; and, although some of the bottles show that red and white are all in a piece, it is difficult to believe that one beautiful buckle of pure cream color, with exquisite red berries, is all carved out of one piece of stone. The next case contained rock crystal, in all sorts of forms, one large block, full of fairy-like forms of grass and reeds, looked like a landscape framed in crystal, the filaments being exquisitely delicate in form and graceful in arrangement. Another quaint form—a Kylian—a jaguar or leopard, has many small, deep, black spots in its very depths, where nature had quaintly set little flakes of carbon. One vase-like form of seal is a splendid piece of the very finest rock crystal, of pure, brilliant white; while other specimens show the same materials, as bottles, and seals, and buckles, of various shades, down to dark green and almost black. The large flat-oval forms of strange color are Chinese seals, made from Siberian rock crystal, and one of the many snuff-bottles shows a spoon and some of the snuff which once belonged to a Chinese emperor. The mineralogist could not avoid noticing one of the freaks of nature in a small specimen of exquisite color and curious form, where a "foot stalk" runs out of, or rather into, the main crystal in an eccentric style; and there was also exhibited nature's strange way of breaking up her own beauteous works in the numerous cracks which slowly extend through the choicest examples of her own cunning art.

In the next case, chalcedonies appeared, in all sorts of form—a dainty little tray, pipes, bottles, double snuff-bottles, and a magnificient example, with a ruby stopper, once in the cabinet of Count Palikao, as part of the "loot" of the Summer Palace at Pekin. Another case contained some remarkable curiosities—large flies made up in rock crystal, a monkey in jasper, boxes in agate, specimens of Swedish porphyry, Scotch and German agates, German and Indian jaspers in many varied forms of boxes, pipes, and slabs. The agates alone not only occupied one whole length of cases nearest the wall, but were also dispersed through the middle case too. These agates are of every conceivable color, and are from Uruguay, Siberia, Nerbudda, the Ural Mountains, &c., and are not only beautiful to the ordinary eye, but are full of interest to the mineralogist and the lapidary. They include all varieties—the mural-agates, which look like the plans of the fortifications of Coelhorn or Vauban, and the moss-agates, of such rare and delicate beauty as only the pen of a Ruskin can describe. The jaspers from the Ural Mountains—ten very fine examples—forming the stem of one pipe, and varying from delicate cream-color to red, and so hard that when painfully cut they serve as pipe bowls for years, the cups and trays of hornstone from Germany, the splendid examples of conglomerate, obsidian, and lava are worthy of the closest inspection and the most unstinted praise. Even amber, which to most people means only a light-yellow, glossy substance, useful for pipe mouthpieces and beads, is there shown in every tint and shade, clear and cloudy, pale and dark, milky-white, and raven-black, and with the traditional long-imprisoned "flies in amber," which are here artistically preserved. These specimens are especially interesting from their size and form, as well as their varied colors; and if the labradorites in the same case are seen with a lucky light, their brilliant iridescence, their flashes of bright dappling color, their banded, striped, and spotted lamina, will never be forgotten. Another and the last case we have left room to mention, contains specimens of almost more interest, because easily appreciable, and yet rarely seen, the specimens of the Shantung cameo-glass—a double layer of glass, generally white, over which a layer of various other colors is fused, and then cut through in cameo-fashion, with marvelous skill and exquisite taste. Many of these specimens will be usefully contrasted with the large glass cup of modern Munich work—a fine contrast of oriental and occidental art. In the same case were three remarkable specimens of pearls—one the shell, the other the natural pearl, and the third a bottle encrusted with artificial pearls, produced by irritating the pearl-oyster to a diseased secretion of the much-prized pearls of fashion.—*London Journal of Applied Science.*

The Sutro Tunnel has been pushed on to a distance of 18,400 feet, and is now within fifty feet of the great Comstock lode, where its usefulness and value will be tested. Thus far the expenditure has been $2,830,597; $250,000 more will complete the work, after which $500,000 will equip it. Its object is to afford a natural outlet for the waters of the Bonanza mines.

THE NEW METAL, "GALLIUM."

Prof. Odling delivered a lecture recently at the Royal Institution, London, on the new metal, "gallium." The Professor said that the number of kinds of matter known to chemists which they have not succeeded in decomposing, but can trace undecomposed through distinct series of combinations, is sixty-four. These have been roughly classified into metals, semi-metals and non-metals, the first class being considerably the most numerous, and the several classes merging gradually into one another. The latest known of the non-metallic elements is bromine, which was discovered in 1826 by the eminent French chemist, recently deceased, M. Balard. Within the last twenty years, however, five new metallic elements have been discovered, being at the average rate of a new element every four years; while some evidence of the identification also of yet a sixth new metallic element has recently been put on record. But the latest known of the fully made out new elements is gallium, which was first recognized by M. Lecoq de Boisbaudran, in the autumn of the year 1875, and so named by him in honor of the land of its discovery, France. Like its four predecessors made known within the last twenty years, gallium was discovered by the process of spectrum analysis, applied in this instance in a special manner contrived by the ingenuity of M. de Boisbaudran himself, long eminent as a spectroscopist. The spectrum of gallium is characterized by two marked violet lines, the less refrangible of them being especially brilliant. Hitherto the new metal has been recognized only in certain varieties of zinc-blende, that of Pierrefitte in the Pyrenees having furnished the chief portion of gallium hitherto obtained from any source whatever—nearly half a ton of this ore having been employed by M. De Boisbaudran to furnish the dozen grains or so of metal wherewith he has been able to establish the leading properties of the element. In its appearance gallium manifests a general resemblance to lead, but it is not so blue-tinted nor quite so soft, though it is really malleable, flexible, and capable of being cut with a knife. Like lead again, and unlike zinc, gallium is not an easily volatile metal. Unlike lead, however, it acquires only a very slight tarnish on exposure to moist air, and undergoes scarcely any calcination at a red heat. The specific gravity of gallium is a little under 6, that of aluminum being 2.6, that of zinc 7.1, and that of lead 11.14. A most remarkable property of gallium is its low melting point. It liquefies completely at 86° Fahrenheit, or below the heat of the hand; and, still more curiously, when once melted at this temperature, it may be cooled down even to the freezing point of water without solidifying, and may be kept unchanged in the liquid state for months. Indeed, in the original communication of its discovery to the French Academy, it was described as a new liquid metal, similar to mercury; but on touching with a fragment of solid gallium a portion of the liquid metal in this state of so-called sur-fusion it at once solidifies. Unlike lead, again, gallium is a highly crystalline metal, its form being that of square octahedron. In its chem-

ical habitudes the rare element gallium shows the greatest analogy to the abundant element aluminum. In particular it forms a sort of alum not to be distinguished in its appearance from ordinary alum, but containing oxide of gallium instead of oxide of aluminum or alumina.

But the chief interest of gallium, from a scientific point of view, is connected with the history of its discovery. All previously known elements have been discovered, so to speak, accidentally, and their properties have been not in any way foreseen, but rather met with as subjects of surprise; but the blende of Pierrefitte was deliberately taken up for examination by M. Lecoq de Loisbaudran in the expectation of finding a new element—an expectation to which he was led in the course of his study of the spectra of known elements, by a train of speculation of which he has not yet made known the details. The existence of an element having the characteristic properties of gallium was, moreover, upon entirely different grounds, predicted very definitely by a Russian chemist, M. Mendelejeff, in 1871, and in a more general way several years earlier by an English chemist, Mr. Newlands. This double prediction was based on a study of the relations of the known atomic numbers of the elements. These numbers have only lately been perceived to form a tolerably continuous seriation, which, again is associated in a remarkable manner with the seriation in properties of the elements themselves. In the series of numbers, however, certain terms are here and there missing, and in particular a number was missing which should belong to an element having properties intermediate between those of aluminum and iridium. What these properties would be was predicted in most minute detail by M. Mendelejeff in 1871. He predicted, for example, that the specific gravity of the missing metal would prove to be about 5.9. Operating on very small quantities, M. De Boisbaudran, in the first instance, found the specific gravity of gallium to be 4.7; but on repeating his determination in 1876, with special precautions and on a somewhat larger though still very small scale, he found it to be exactly 5.935—certainly a most remarkable fulfillment of the prediction with regard to it.

—*London Chemical News.*

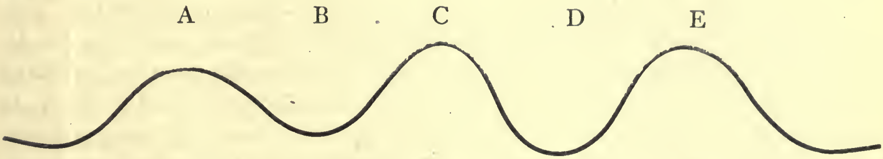
ARCHÆOLOGY.

ANCIENT EARTHWORKS IN SALINE COUNTY, MISSOURI.

BY PROF. G. C. BROADHEAD, PLEASANT HILL, MO.

In 1872 I visited an interesting locality in Saline county, about four miles southwest of Miami, where were observed ancient earthworks, walls and ditches, on a high ground in a dense wood. It approached a circular form, though of quite irregular shape, caused by ravines breaking off near the periphery, the

walls becoming reëntrant at such places. The space enclosed was about forty acres, around which there extended three ridges and two valleys or depressions, the remains of former ditches. The cross section of which was about as annexed:



A—1½ feet high, 10 feet wide. B—10 feet wide, 3 feet deep. C—3 feet high, 8 feet wide. D—6 feet wide, 3 deep. E—3 feet high, 8 feet wide.

The two ridges C and E extended entirely around the enclosed area and apparently were formed of the earth excavated from the ditches, and are about three feet above the bottom of the ditches. They have undoubtedly been much higher, the ditches correspondingly deeper, at some former period in the remote past. No rocks were seen near by or in the inclosure. Black oak trees from three to five feet in diameter were noticed as growing over the walls and ditches and the inclosed area of the entire space was covered with a dense growth of bushes, vines and trees. In the neighboring fields human bones, spear heads and fragments of pottery have been plowed up. I, myself, observed in the neighborhood many fragments of pottery, with arrow and spear heads of flint.

INDIAN STEATITE DISHES.

A very interesting discovery has recently been made by Mr. H. N. Angell, of Providence, R. I., showing how the Indians formerly manufactured steatite dishes. As he was quarrying about a ledge of rocks near his home, early in the month of February, he came upon a bed of soapstone, which bore evident traces of having at one time been artifically worked. Cart loads of steatite dust and chippings were removed before the ledge could be uncovered, when it presented a very peculiar appearance, being covered by protuberances and depressions. A number of finished vessels were obtained and many more in partial state of completion. The pots were first rudely carved out of the rock with slate or stone knives and chisels, bottom-side up, and were then removed from the mass by inserting wedges beneath them, after which they were hollowed out. Mr. Angell states that "the soap-stone bed, as now uncovered, is about thirty by ninety feet in extent, and all of the surface has been worked. We found by excavating in other places in the vicinity, stone hammers, chisels and sledges that will weigh from fifty to one hundred and fifty pounds. We also found a rudely wrought stone which resembles a plough and which will weigh over one hundred pounds." The bed of steatite had been lowered several feet by the removal of the stone, and it is certain that great numbers of vessels were fashioned at this quarry.

—*Amer. Naturalist.*

OBSERVATIONS ON THE DIGHTON ROCK INSCRIPTION.

BY CHAS. RAU.

In an article on the lately discovered Davenport tablets (published in Vol. II. of the proceedings of the Davenport Academy of Natural Sciences), Dr. R. J. Farquharson enumerates the inscribed stones found in this country, including among them the celebrated Dighton Rock, near the mouth of Taunton River, in Massachusetts. This rock, as is well known, bears an Indian pictograph, which has been quite plausibly interpreted for Mr. Schoolcraft by Chingwauk, an intelligent Algonkin Indian. He threw out, however, several characters, stating that they had no significance; and some of these, in connection with others actually explained by him, have been thought to form a runic inscription denoting the arrival of the Northmen in the present State of Massachusetts several centuries before the Columbian discovery. The translation, as given by Professor Finn Magnusen, of Copenhagen, runs thus:

"151 Northmen under Thornfinn took possession of this land."

Dr. Farquharson says in his article: "As this reading accords almost exactly with the long lost and recently found Saga of Thorfinn Karlsefn, and is accepted by the French runologists, it may be accepted as the true one."

"The confidence inspired by this successful reading," he continues, "induced the Royal Society of Antiquarians of Denmark to purchase this rock, and arrangements were very recently being made to remove it to Copenhagen. The excitement caused by this movement culminated lately in a public meetlng at Boston, and other arrangements were there made by which this important monument of our early history is to be preserved and transported to that city. In consideration of this concession on the part of the Danish antiquaries, a granite monument is to be erected on the spot now occupied by the engraved rock, thus to commemorate the landing here in 1007 of Thorfinn, as narrated in the Saga, and in the inscription, as read by Magnusen."

If such is really the case, the good citizens of Boston may rejoice in the prospect of two grand celebrations with the usual accompaniments of flag-waving, speeches and other proceedings characteristic of such occasions. But would it not be well for them to pause before they carry out their plan of placing a monument at the mouth of Taunton River, and to consider whether the Danish runologist's interpretation can stand the test of scrutiny? If not, they run the risk of commemorating something that probably never happened. It is not surprising that a people to whom, owing to the short duration of its existence, the romantic element of an ancient history is denied, should evince an inclination to acquiesce in the acceptance of a vaguely intimated occurrence to which the character of a historical fact cannot be attributed. Yet such a tendency is totally at variance with the spirit of keen inquiry characterizing our time, and therefore should not be fostered, but should be made to yield to the dictates of sober judgment. I leave for a moment the Dighton Rock inscription, and its interpret-

ation by Finn Magnusen, in order to make some statements concerning *another* attempt of the same gentleman at deciphering runes.

The venerable chronicler, Saxo Grammaticus, gives an account of a great battle fought in Sweden on Braavalle heath, close to the boundary of Oestergotland and Sodermanland. The contest was between King Harold Hildetand of Denmark and the Swedish King Sigurd Ring, the first of whom was slain in the battle which is supposed to have been fought about the year 700 of our era. A runic inscription relating to this battle was said to be engraved on a rock in the Swedish province of Bleking. The rock is called "Runamo" by the people of the neighborhood. The spot was visited at different periods by antiquaries, but none of them attempted to explain the marks supposed to be runes. In the year 1833, however, the Royal Danish Academy of Sciences concluded to send a committee of scientists to the spot, to investigate the subject thoroughly and report with regard to it. Professor Finn Magnusen was a member of that committee. As it would be foreign to my purpose to describe the operations of these gentlemen in detail, I come at once to the point by stating that in 1841 Professor Magnusen published an illustrated quarto work of 742 pages, under the title of *Runamo og Runerne*, the principal feature of which is his translation of the marks on Runamo Rock. He made the following inscription:

Hildekind occupies the empire
Gard cut in (the runes)
Ole gave oath (oath of allegiance)
(May) Odin hallow the runes
(May) Ring fall
On the earth
Alfs, lovegods
(Hate) Ole
Odin and Freja
And Aser's decendants
(May) destroy our enemies
Grant Harrold
A great victory

As will be seen, the purport of the inscription is an invocation against the enemies of Hildetand, whose name, however, is read "Hildekind." The runes, Professor Magnusen states, are of an intricate character, and must be read from right to left. But now comes the reverse of the medal.

In the year 1842, and afterward in 1844, the Runamo Rock was visited for the purpose of examination by the distinguished Danish archæologist, J. J. A. Worsaae—the second time in the company of an artist, who took different views of the locality. Again, I cannot enlarge on Mr. Worsaae's most thorough investigations, but must confine myself to a statement of the final result he obtained namely, *that there is no runic inscription whatever on Runamo Rock, and that the marks considered as runes by Finn Magnusen are simply the natural cracks on the decayed surface of a trap dike filling up a rent in a granitic formation.*

The arguments brought forward by Mr. Worsaae are to me absolutely convincing, and cannot fail to produce the same effect on every unbiased reader who peruses his amply illustrated work on the subject. It appeared in 1844 at Copenhagen under the title *Runamo og Braavalleslaget. Et Bidrag til archæologisk Kritik*

or "Runamo and the Braavalle Battle. A Contribution to Archæological Criticism." The work was translated into the German language under the author's supervision, and published in 1847 at Leipzig as the second part of a highly illustrated quarto volume, entitled *Zur Altertnumskunde des Nordens.* A copy of this translation (perhaps the only one in the United States) is in my possession, and may be inspected by any one particularly interested in the subject.

I should not omit to state that Mr. Worsaae speaks throughout the work in terms of the highest consideration of his colleague, Professor Finn Magnusen; yet his personal regard could not prevent him from exposing the grave error of this meritorious scholar, who allowed himself to be led astray by a too lively imagination.

In view of the foregoing it may be pertinently inquired: What confidence can be placed in Magnusen's interpretation of the Dighton Rock inscription? Any one who will take the trouble to examine in the published drawing that part of the Dighton Rock inscription supposed to be of Scandinavian origin, must perceive at once on what shadowy basis the presumption rests. Even Schoolcraft, who professes to believe that the Northmen sculptured runes on Dighton Rock, could not conceal his scruples as to the correctness of the translation furnished by Professor Magnusen. I may revert to this subject in another article.

The evidences brought forward to prove in a tangible way the presence of the Vikings of the North in the so-called Vinland have certainly thus far been very unsatisfactory. The "Skeleton in Armor" disentombed near Fall River was doubtless that of an Indian, buried, perhaps at a comparatively late period, with some weapons and ornaments made of sheet brass—a material with which the New England settlers are known to have supplied the natives. The "Round Tower" at Newport, Rhode Island, is now considered as the substructure of a windmill, erected during colonial times. For details, I refer to a curious little pamphlet, entitled "The Controversy touching the Old Stone Mill in the town of Newport, Rhode Island," (Newport, 1851). What will be thought of the supposed Scandinavian inscription on Dighton Rock at some future time, when pardonable credulity will have yielded to severer methods of investigations?

All this, however, does not invalidate my belief that the Northmen were pre-Columbian discoverers of America.

—*American Antiquarian.*

JAPANESE ARCHÆOLOGY.

Japan has an active archæological society bearing the title of Kobutzu Kai (Society of Old Things). Its members, numbering 200, are scattered throughou the land, but meet once a month in Yeddo. They consist chiefly of wealthy Japanese gentlemen, learned men, and priests; the latter especially have been the means of bringing before the public attention a vast number of ancient objects hidden in the treasuries of the temples or preserved in private families. H. Von

Siebold, attaché of the Austrian Embassy at Yeddo, and a member of the society, has lately published a *brochure*, which will serve as a guide for the systematic archæological study of the land; Von Siebold has lately made a most interesting discovery of a prehistoric mound at Omuri, near Yeddo, containing over five thousand different articles in stone, bronze, etc. In a recent communication to the Berlin Anthropologische Gesellschaft, he describes the origin of the terra cotta images found in old Japanese burial grounds. It appears that up to the year 2 B. C. it was the custom to surround the grave of a dead emperor or empress with a number of their attendants, buried alive up to the neck, their heads forming a ghastly ring about the burial spot. At the date referred to the custom was abolished, and the living offering were replaced by the clay figures which have hitherto attracted so much attention.—*Nature.*

DESCRIPTION OF SOME INTERESTING STONES FOUND IN CLEONA TOWNSHIP, SCOTT COUNTY, IOWA.

BY REV. J. GASS.

A number of remarkable stones, with ancient engravings, are imbedded in a creek about twenty-two miles west of Davenport. I visited the place twice to obtain the needed information and help for the exploration. The second time, *i. e.*, on the 15th of May, I discovered five inscribed stones. Two of them are now in our Museum, and the other three, even if I had the power to move them out of the creek, would have been too heavy for my vehicle, though one of them, the largest and most important, covered with many inscriptions, might be of particular value to our Academy.

Some other stones of more or less importance will, perhaps, be found there when the water in the creek is lower.

Now, the whole group of stones, except the largest one, is below the surface, and it was only by several hours of arduous labor that I could accomplish what I have already done.

For a further exploration, I have obtained from the kind owner of the farm, a written permission, and with the assistance of the Academy to hire some help, I shall be able to obtain possession for our Museum of some more of these relics, so valuable for investigation and comparison, and to gain additional facts for a second and more detailed report.

—*Davenport Academy Report, 1877.*

REPORT OF EXPLORATION OF MOUND NO. 10, COOK'S FARM GROUP.

BY REV. J. GASS.

Having recently explored another mound of the Cook Farm Group, near Davenport, I would respectfully present the following brief description of it:

This mound, which we will designate as Mound No. 10, is situated in the second or northwesterly row of mounds, and is ninety-five feet northwest of Mound No. 1, and one hundred feet northeast of Mound No. 5. It should be mentioned that these mounds have been numbered in the order of their exploration, and without reference to their relative position. Mound No. 10 is the smallest and least important one of the group. It was about fifteen feet in diameter, and about eight inches above the surrounding surface. All the mounds in this row, viz: Nos. 7, 5 and 10, are less elevated than those of the other line. Six inches below the surface I found a pile (or altar?) of stones, which were packed closely together throughout, and although of irregular size and form, they were so arranged as to present a tolerably even surface on each side of the pile, which was three and one-half feet long from east to west, and two and one-half feet from north to south, and two and one-half feet high. The whole pile rested upon the high, undisturbed clay at the bottom of the excavation, and three feet above the surface of the ground. The excavation was about ten feet long from east to west, and six feet wide, rather more than two feet deep, and rounded at the corners and bottom, being of the same form as those already described in Mound No. 3. The mound was three feet in depth, from the surface to the hard clay at the bottom of the excavation. In the lowest layer of the pile was a flat stone, two feet long, ten inches wide, and about two inches thick, lying with the smoother side downward. Beneath this stone I found fragments of the leg bones of a human body, pressed down into the clay. About two to two and one-half feet west from this pile, and one to one and one-half feet below the surface, was a small layer of the usual river shells, about three feet long from north to south, and two and one-half feet wide and one inch thick. This layer was in an arched form, the north and south edges being curved downward. The shells were much decayed, and not a single one could be preserved. Three or four inches below this shell layer, and directly under the middle, were several fragments of pottery, evidently comprising not nearly all of the original vessel, and three small polished stones. The pieces were nicely packed together in a little pile, showing clearly that they were thus broken before being placed there. No farther indications of relics or human hones could be discovered.

The articles above named are in the cabinet of the Academy, and although but few relics were obtained, the observation of the structure and arrangement add something to our knowledge of the subject, and especially of this very interesting group.

—*Proceedings of the Davenport Academy of Science, 1877.*

PROCEEDINGS OF THE KANSAS STATE ACADEMY OF SCIENCE.

SEMI-ANNUAL SESSION, AT KANSAS CITY, MO.

REPORTED BY PROF. J. D. PARKER, KANSAS CITY, MO.

On the invitation of the Kansas City Academy of Science, the semi-annual session of the Kansas State Academy of Science was held in this city Thursday and Friday, June 6th and 7th. The members present were: Profs. B. F. Mudge, Frank H. Snow, G. H. Collier, F. W. Bardwell, George E. Patrick, James Marvin, Judge F. G. Adams, Joseph Savage and wife, J. A. Lane, Frank O. Marvin, E. A. Popenoe and wife, Mrs. F. W. Apitz, F. B. Ashton, Judge Hutchins, Hon. G. A. Crawford and Gen. Halderman; also, Prof. G. C. Broadhead, from Pleasant Hill, Mo., as a visitor, and several citizens of Wyandotte and other neighboring towns.

Col. Van Horn, president of the Kansas City Academy of Science, called the meeting to order and gave the opening address. He said:

Mr. President and Gentlemen of the Kansas Academy of Science:

When our young society first thought of asking you to meet in our city we scarcely dared to hope for the honor. Not because of your indisposition, but that your rules might forbid. We were more than gratified to find it was not so, and we are honored beyond our deserts in your acceptance and presence here among us.

Science is the noblest, as well as most delightful, of human pursuits, and its followers, next to its teachings, delight in conferring benefits upon its disciples. It is to this that we owe your acceptance of our call. It was your example and one of your number that led to the formation of our society, and we desired above all things to have the opportunity to meet with and learn of those who have made the Kansas Academy of Science an institution of such wide usefulness, and given it a reputation that is more than national.

We are here to be your servants and your pupils, and it will be one of the memorable events of our history that you have opened for us our second year. Our Academy has been most fortunate —it was inaugurated by the distinguished astronomer of England, Richard A. Proctor, and now our second year opens under the auspices of your, to us, venerable society, in the discussions and transactions of one of its regular meetings. If, then, your visit among us brings to you in even a small degree the satisfaction it affords to us, we shall be amply rewarded. In the name, then, of the Academy and of the whole people of Kansas City, I give you a cordial, and as far as we can make it so, a hospitable welcome. This edifice, our services, and all that we can do to further your

wishes, is now at the service, Mr. President, of yourself and your associates. All is in readiness, that you may proceed to the duties that have called you together.

Col. Van Horn then introduced Prof. Snow, president of the Kansas Academy of Science, who responded, in substance, that it gave the scientific men of Kansas the utmost pleasure to accept the kind invitation extended by the Kansas City Academy of Science to hold their semi-annual meeting in Kansas City. We live in different States, but scientific workers cannot be separated by State lines. Kansas City sustained vital relations to his State; indeed, he thought it ought to be in Kansas. At the annual meetings their papers were more strictly of a scientific character, but at the semi-annual meetings the proceedings were of a more popular character. Members discussed facts coming within their observation since the last meeting, or made scientific excursions. He was glad there was one planned for the morrow to the mounds of Clay county. They would report at night after their return, giving their observations. These mounds, sometimes, were very rich in the remains of the prehistoric races. He trusted the present meeting would be interesting and profitable to all concerned, and bind the scientific men of Kansas City and Kansas more firmly together.

Prof. Mudge was then introduced, who gave an interesting lecture on the "Rocky Mountains and their Fossils." He first explained the general principles underlying the formation of mountains. Mountain ranges are wrinkles in the earth's crust resulting from the condensation of the interior or melted portion, leaving it to wrinkle or be thrown up in ranges, as the flabby cover too large for the ball would contract, forming wrinkles. The lowest mountains are, therefore, the most ancient. The Laurentian mountains, in Canada, are the most ancient on this continent. The Professor then gave a sketch of the mountains east of the Mississippi. The Rocky mountains are the youngest of the family on this continent.

Mountain making was a gradual process. Perhaps the Alleghany system was a million years in their formation. Visiting the Rocky mountains we find sometimes the rocks tilted up until they stand on their edges. These blocks were once horizontal, lying beneath the primal ocean. The speaker then cited instances where rocks of the Jurassic and Triassic age were tilted at various angles, while the Cretaceous rocks were horizontal. In or near the South Park there is a small valley four or five miles long and half a mile wide, containing a fossil forest. The trees have mostly disappeared, leaving the stumps. The trees were once probably immersed in a warm stream charged with silica. Prof. Mudge found insects fossilized as perfect as life, and once he found a fossil butterfly. These insects could not live there now, therefore the climate must have been warmer.

The lecturer then gave an interesting account of the formation of Pike's Peak and the neighboring mountains. He showed the mountains had subsided 15,000 or 20,000 feet and then been raised to their present position. He saw shells of the Potsdam formation found 1,400 feet above the sea level.

The speaker then gave a theory to account for the great natural parks in Colorado.

The closing portion of the lecture was devoted to the fossils of the Rocky Mountains. These monsters of ancient geological times have been wonderfully preserved. He found dinosaurs which would measure 70 feet in length, and hold their heads 30 or 35 feet from the ground. Beds of lava were found that had extended 40 miles in length. The lecture was replete with information and held the audience with fixed attention to its close.

On the second day the members of the Kansas Academy of Science, accompanied by the members of the Kansas City Academy, made an excursion to the mounds on the north side of the Missouri river, the party, including several ladies, numbered over thirty. These mounds, the remains of a *prehistoric race*, are situated on a crest of a high ridge about a mile from the Missouri, near Line creek, on the Platte side of the line between that county and Clay, and about five miles from Kansas City. They are found all along the line of bluffs as far east as Randolph. One peculiarity of these mounds is that nearly all, so far opened, contain a stone walled chamber, from 7½ to 8½ feet square, with an entrance about 2½ feet wide. The walls are about 3 feet in height. In all of them, so far opened, there have been found human remains, flint implements, and in some cases pottery. Three were opened, but only two of them were fully explored. Eleven skulls in all were found, together with other bones, teeth and jaw bones containing the teeth. But few flint implements were found, and no pottery. Some of them, heretofore opened, contained evidences of fire having been used in them. The skull bones exposed to the air crumbled very much, but one was secured in a very good state of preservation. Some of the teeth were remarkably perfect, as were the toe bones, and some others.

Profs. Mudge and Broadhead were both present superintending the operation. One skeleton was uncovered almost perfect, but the bones were too brittle to be saved entire. The heads were all found next to the walls, showing that they had been regularly laid away, but the bones were scattered—some of them showing unmistakable evidence of being gnawed by some animal. These, with the fine state of preservation of most of them, led to the supposition that part of the remains must have lain above the ground for some time and dried, and afterwards gathered and entombed with the others. It is a well-known fact that rodents do gnaw dry bones, squirrels being seen doing so. All these facts taken together—the small size of the stone chambers, the absence of anything of what might be articles of personal use, buried with the owners, and the gnawed bones—led to the conclusion that they were places of sepulture only, and that those who used them lived in habitations adjacent of less durable material. The location of the mounds is very regular, and every one of them has an outlook on the Missouri and the Kaw Valley—the view from them being one of the finest, as to landscape, to be had from any point for miles around. The day was cool and pleasant, and the excursion passed off to the satisfaction of everybody, and our guests were delighted at the success of their undertaking.

On Friday evening a large andience gathered in Dr. Bell's church to hear a lecture from Prof. Bardwell on Navigation, and to hear the report of the excursion to the mounds. Prof. Bardwell being introduced, said:

A short time before the close of the college year, I was invited to prepare a lecture for this occasion, and without much reflection, accepted the invitation. Under the most favorable circumstances you could not well expect an eloquent address from an engineer. Scientific men occupied with the study of nature, as for instance the botanist or geologist, naturally become eloquent. Their labors take them into the broad fields of nature, where they gather inspiration from labor and all their surroundings. Eloquence becomes with them a habit, and they are ever ready to speak out in the fullness of their enthusiasm. Of this we had a pleasant illustration. On the other hand, as the chairman informed you, the engineer is very practical. He is occupied chiefly, not with organic, but inorganic nature, with raw materials—perhaps with piles of sand and mortar; or estimating the strength of a retaining wall, supporting an embankment, or it may be busied with a series of mathematical formulas. Now there is nothing soul-inspiring in the contemplation of a bed of mortar, or even in an array of mathematical symbols; there are no crystals of wit found incrusted in a bed of concrete, and if the engineer by manipulating cement causes it to harden in water, you need not be surprised to find that even with a wet subject he is able to produce a dry discourse

It is clear that I should not have accepted the invitation to appear here at this time, but there was one greater mistake made before that, that was in giving me the invitation. This was the fault of our chairman. I hope you will forgive him this time, and I am sure he will promise never to do so again: It was announced that my subject would be "River Navigation," but a glance at the general subject, it seems to me, is really needed to make that consideration satisfactory. The history of navigation is useful for the practical lessons which it teaches; but it also possesses an interest for the general student, on account of the close relation which has ever been found to exist between skill in navigation and a high degree of civilization. Looking back in the dimmest vistas of ancient history, we catch glimpses of that curiously interesting people, the Phœnicians, remarkable for their exploits on the sea, and as remarkable for the high state to which they carried the arts of civilization. In language and lineage the ancient Hebrews were closely allied to them, and we read that Hiram, king of Tyre, sent a skillful artificer to do the finest work for Solomon in finishing his temple. This was about a thousand years before Christ. They must have been a flourishing people long before that. The present city of Cadiz, in Spain, was founded by a colony of Phœnicians more than 3,000 years ago, that is about 200 years before the time of Solomon, and it is probable at that early day they sailed out into the Atlantic and visited Great Britain for the purpose of obtaining zinc and tin.

They had a knowledge of arithmetic and astronomy, which they used in navigation. From them Greece received their alphabet, learned the rudiments of arithmetic, as indirectly have all the nations of Europe. Here let me digress for

the moment to say that arithmetic is, of necessity, the oldest of sciences, older even than astronomy, and I have explained elsewhere that this fact in some measure accounts for the crudeness that even yet points to the elements of this science, so essential to the wants of men in all ages and in all degrees of civilization.

At a later day the Greeks learned the art of navigation, and it is possible that the ancient mariner of the Greeks, Jason, who led the Argonautic expedition, owed his skill directly or indirectly to the Phœnicians. The Greeks became distinguished for their commerce as well as for their culture. A historical writer says:

"It is noticeable that Athenian commerce was at its highest at the same time that Athenian genius was most prolific in philosophy, poetry, history, oratory and the fine arts."

I will merely mention as a later illustration of this intimate relation of commerce and civilization, Venice, and in our own day, England. It was Raleigh who said, "Whosoever commands the sea commands the trade of the whole world, who commands the trade, commands the riches of the world and the world itself." Here let me remark that in her recent negotiations with Russia and the powers of Europe, England astonished many by her success, when it was supposed the Russians had made themselves masters of the situation and were able to dictate their own terms. English supremacy is by no means a thing only of the past. Her right hand has not yet lost its cunning.

The first great advance of modern times in the art of navigation was made when the mariner's compass was made available. The Chinese, before the Christian era, knew the polarity of magnetic iron, and, placing bits of it upon pieces of cork floating on water, were able to determine direction It is said that Marco Polo brought a knowledge of this to Italy in 1260 and it was known in France still earlier, and indeed in other European countries. But a Neapolitan, Flavio Gioa by name, was the first, it is believed, to devise a construction like the present mariner's compass which could be used by the ordinary seaman. This opened a new field to commercial enterprise, soon led to the discovery or rediscovery of this Western world, and indeed, entirely changed the course of the world's history.

Yet even after the introduction of the compass, the mariner had many difficulties to contend with. Mercator's chart was of great value in helping to avoid some of these, and the quadrant, or in the form now used, the sextant, became invaluable. The simplicity, the convenience and accuracy, add to these improvements in tables, resulting from the progress in astronomical science and the use of logarithms in computation, with improvements in naval constructions, and we reach the ultimatum obtained in the art of sailing. In this branch of the subject let me detain you but a moment longer. It is now a little more than one hundred years since Maskelyne issued the first nautical almanac under the direction of the British, and it has appeared without interruption every year since The American nautical almanac appeared for the year 1855, and continues without interruption. The almanac furnishes those astronomical facts and computations which are of the highest importance to the mariner even of to-day. I wish especially to call your

attention to the fact that in this way the science of astronomy has served a most important part in the progress of modern civilization.

A second great advance in the art of navigation was instituted by the successful application of steam to the propulsion of boats. Of course the name of Robert Fulton first occurs to the mind. The history of his efforts to inaugurate steam navigation would of itself furnish ample material for the evening's lecture. A glance at a few salient points must suffice our present purposes. In the first place, he was not the original deviser of a boat propelled by steam power. This had been the object of effort in England and France, as well as in this country. In fact, Fitch had constructed a skiff to run by steam, and another small boat that moved at the rate of seven miles per hour. But no satisfactory result had been reached whereby profitable use could be derived from the steamboat. Fulton had passed some years in France and England and was familiar with all that had been attempted there. He also gave a great deal of time to the invention of a submarine torpedo, and it is probable that he was the original inventor of this machine, though he never made it completely successful; but he never doubted that success was possible, and as his mind became engrossed with the other problem, that of propelling boats by steam, he gradually neglected the torpedo. He was successful in enlisting the interest of prominent men in his undertakings, and his views attracted attention from such men as Pitt and the Earl of Stanhope in England, and Jefferson and Madison in this country.

While in France he made the acquaintance of Chancellor Livingston, then U. S. minister to that government, and on their return to this country, Livingston joined with Fulton in the effort to make steam navigation practicable. Previous to 1807 Fulton had succeeded in propelling boats by steam, but it was not till that year, that having completed the Clermont, it was admitted that actual utility had been gained.

A committee of the great exhibition in London of 1851 had occasion to refer to this matter, and reported as follows: "Many persons in various countries claim the honor of having invented small boats propelled by steam, but it is to the undaunted exertions and perseverance of the American Fulton that is due the everlasting honor of having produced this revolution in naval architecture and navigation. With his inventive genius he possessed versatility of talent, and showed a marked degree of artistic power. He is described as having been "slender of person, above the ordinary stature, with large dark eyes and features of manly beauty." In enlisting capital and official influence in behalf of his projects, he exhibited uncommon tact, energy, patience and enthusiasm. He had the manners and address of a gentleman. It is seldom that one in private life obtains so great a degree of personal popularity, and his death was mourned as a national calamity.

Since the time of Fulton great improvements have been made in various ways in the carrying capacity and in the speed and efficiency of boats inaugurated on the rivers; it soon extended to the ocean, and to-day few realize the extent to which steam navigation enters as a potent factor in the affairs of all civilized people.

The construction of wheels has perhaps received more study from inventors than any other feature of the steamboat. The amount of ingenuity that has been expended in this one problem, as shown by records in the patent office, seems scarcely credible. In many cases, the screw, as a means of propulsion has taken the place of the side wheel, especially on the ocean. At present the advantages of either do not greatly overbalance those of the other, but in ocean navigation the screw is gaining in favor. With regard to the screw, I should say it did not at first receive favor from practical men as distinguished from scientific men. I shall have occasion to refer to this again.

Before taking up the consideration of a wheel which I have to show you, I ought to allude to the importance of developing river navigation. But probably your attention has been called to this, and a passing allusion is all that is needed.

I believe, however, that few realize the extent of the navigation of the Mississippi river system, including all its navigable tributaries. It is said there are fifteen hundred miles of such branches below the mouth of the Arkansas, and when we think of the great branches above this point, together with the smaller branches, secondary to these, we must truly admit that the improvement of the Mississippi and its branches has better claims to be regarded as of National importance than is possible for any single harbor improvement on the sea coast.

Before leaving this part of the subject, let me refer to what seems to be a wise policy on the part of the railroad management in the transportation of produce from the West to the East. The farmers of Kansas complain that the railroad companies make a close calculation of what amount less than the market price at the East, say for corn, may be charged, so that the farmer can barely live, yet without making any profit. The fact is, if the freight companies should put down freight prices very low, the farmers would expend their energies in raising and shipping corn, and soon exhaust their fertile plains. By a wise dispensation of Providence they are discouraged from this by the management of the railroad companies, and at the same time are led to engage in stock-raising and fruit, which do not exhaust the resources of the soil.

At this point Prof. Bardwell exhibited some diagrams and models illustrating water wheels. Navigators desire to increase the speed of vessels. Fishes move at great speed. Porpoises swimming beside vessels dart out some distance and return without falling behind the vessel. Steamboats sometimes make a spurt at twenty-five miles an hour, others make twenty, fifteen or twelve miles an hour. Why cannot vessels move as fast as fishes? There are several defects in the common paddle wheel by which it loses power. The paddles sometimes lift the water and are made feathery to avoid this defect. The paddles strike the water and displace water. In all displacement of water there is a loss of power. The common paddle pushes the water and thus propels the boat. This wheel (of which this is a model) is a traction wheel. In an experiment made it was agreed that it worked better than the common paddle wheel. The common paddle wheel is a heavy wheel, loads the boat and causes the boat to draw more water. In this respect the traction wheel is superior.

Prof. Mudge then gave an account of the excursion to the mounds. He said in substance that about thirty went out to the mounds. He thought the mounds might have been some higher than at present, and kept up for a time by new earth. In the first mound we found four skulls. One skeleton lay out extended, the head resting on a stone. It measured about five feet ten inches. The bones of one indicated a height of six feet two inches. We only found one spear head, which measured about six inches in length and two in width. It was unfortunately broken by the spade. In one of the vaults was found a stone wall laid up as nicely as could be done by a stone mason. The stone was brought from a quarry about three-fourths of a mile away. These cysts had entrances from the south. In the last vault were found the most remains. There were two floors of flat stones. In this there were found *eight skulls*. The bones had been gnawed by some wild animals. The bones may have lain on the ground until the flesh disappeared, and then they were buried in the vault. The Cheyennes often do this. Some of the skulls showed good intellectual development, and some were quite low. In one of the mounds we found charcoal and evidences of fire in the shape of clay burnt red.

We know from the remains of the Moundbuilders something about their character. They were something in advance of the North American Indians. Probably they were the progenitors of the Toltecs. Their pottery was made by constructing a grass basket of the shape of the vessel. After the vessel hardened the grass basket was burnt off. The copper mines of Lake Superior were worked by the Moundbuilders. They took out more ore than we have taken out in forty years. They cultivated the ground. They wove cloth as fine as twelve strands to the inch. They worked mica. This race covered a large part of the Mississippi valley. Here the professor displayed the skull of a Moundbuilder. It seemed to be of a rather savage man. Prof. Snow stated that on one of the mounds was a stump having two hundred rings. Judge Adams read an extract from Rev. Isaac McCoy's account of Indian Missions in the West showing that mounds have been discovered in Kansas.

Prof. Snow then gave a laughable incident connected with the recent excursion, indicating that the present meeting was not devoid of subjective tendencies on the members. After thanking Kansas City for the rich treat afforded them, inviting the members of the Kansas City Academy of Science to attend their next annual meeting, and declaring the present semi-annual meeting a success in every respect, he declared the meeting adjourned.

After the adjournment Col. T. S. Case exhibited a number of photographs showing the effect of the Richmond cyclone upon that city, which were examined with decided interest. He also presented for inspection a specimen of the solid hoof of the new species of Texas hog, which has produced so much discussion among scientific men. Much interest was manifested by the members in this specimen, some claiming it as an evidence of evolution, and others, notably Prof. Mudge, declaring it to be nothing more than a somewhat persistent monstrosity.

ASTRONOMY.

A MANUFACTURED COMET.

The work of making astronomical observations is about the most laborious and trying in which an intellectual man has ever to engage. Any difference of temperature between the air which surrounds him and that outside would be fatal to the accuracy of telescopic vision; so that no matter how cold the night may be, not only must no artificial heat be allowed him, but he must take special pains to have his observing-room as cold as the outer air. He must sit perfectly still, his attention concentrated upon the object which he is scrutinizing. Gloves can hardly be allowed him, because they would interfere with the delicacy necessary in handling his instrument. And whether it be warm or cold, he must pursue his avocation during the hours when the rest of the world are enjoying themselves in sleep. If he wants to discover a comet, he will find the search as trying to his patience as the observations are detrimental to his physical comfort. He may scan the heavens with unwearying assiduity on every clear night during an entire year, and yet not be rewarded with a single discovery.

All this the Chevalier d'Angos learned from sad experience. This gentleman was one of the famous Knights of Malta, during the latter half of the last century, and being imbued with an astronomical taste, had built himself a small observatory, or perhaps got it built by the brotherhood. He was known in the astronomical world as the computer of cometary orbits at a time when such computations were much more difficult than they are at present. But up to the time when our story commences, although he had made a few observations with his telescope, he was not known to have made any discovery whatever. It was in the year 1784 that a happy thought struck the ambitious knight, the development and results of which form the principal subject of our story. In May of that year, Messier, of Paris, celebrated as the discoverer of comets, received a letter from D'Angos stating that he had discovered a small comet without any tail on the night of April 11th. At first he supposed it to be a nebula. Still, in order to make sure of it in case it should prove to be a comet, he had carefully fixed its position among the stars.

Two or three cloudy nights followed, when he found it again, and saw that it had moved several degrees. He now knew it was a comet, and therefore communicated his observations to the Paris astronomer. In the following month the observatory at Malta was destroyed by fire, with, as was supposed, all its papers. It was therefore feared that this was the last of the comet. In those times it took a month for a letter to reach Paris from Malta, so that when Messier heard of the discovery it was too late to find the comet. But a couple of years afterward there

appeared in a mathematical journal published by the celebrated Bernulli a series of observations on the comet by D'Angos, extending from the 11th of April to the 2d of May; also a set of elements, supposed to be derived from the observations, showing in what orbit the comet moved around the sun. D'Angos added that the elements represented the observations with almost entire exactness. So far there was nothing at all to excite suspicion; but when mathematicians came to scrutinize these observations more closely, they were not only unable to reconcile them with the orbit given by D'Angos, but, in fact, with any orbit whatever. No heavenly body had ever been known to move in an orbit so erratic as that which the observations would indicate, while the orbit assigned by D'Angos would have placed the comet in a quarter of the heavens entirely different from that in which he professed to have observed it. Evidently there must be some mistake in the numbers given by the Chevalier. But it was impossible to correct them in such a manner that the corrected orbit would represent the observations. The nearest approach that could be made was to suppose the comet so near the earth as almost to move around it like a satellite. A suspicion that the whole thing was a fabrication now began to gain general credence. But beyond the seeming impossibility of representing the observations, no proof of the fabrication could be afforded. When the observatory was burned, all the papers were burned with it, so that it was impossible to refer to the original records. No one else had seen the comet, but then D'Angos himself said it was a very faint one; consequently it might well have escaped notice. Finally, if the observations were entirely fabricated, it would be supposed that the Knight would take good care to have them correspond to the orbit which he had marked out, whereas, as we have said, there was no such correspondence whatever. What made the thing still more inexplicable was, that D'Angos understood perfectly the art of computing cometary orbits as then practiced.

Thirty years passed away, and D'Angos was dead and gone before any new light was thrown upon the difficulty. The comet still figured among the discoveries of that year, but no one had explained the observations. Olbers, about 1820, subjected the latter to a new examination, and, like others who had done so, was led to the conclusion that no comet could have moved in the manner in which D'Angos pretended to observe it. The only explanation seemed to be that he had assumed some orbit, calculated how the comet would appear from the earth if it moved in that orbit, and then pretended to have observed it in the calculated positions, but that in making his calculations some mistake had crept in. Olbers asked Encke to take up the subject and see if he could meet with any better success in explaining the matter. Encke satisfied himself, as others had done before him, that it was impossible to represent the observations by any admissible orbit. At length, after many trials, he took the orbit of D'Angos and sought to find in what way it would have to be changed to represent the observations. The clew to the whole forgery was at length reached. Take this orbit, but multiply all the distances of the comet from the sun by ten, which merely involves a mistake of one figure in a certain logarithm, and the observations are all repro-

duced pretty much as D'Angos gave them. The mystery was then solved. The Chevalier, anxious to figure as the discoverer of a comet, had imagined this orbit; supposing the comet to move in it, he calculated the positions in which it would appear from the earth; but by one of those accidents which so frequently happen to the dishonest, he had made a mistake of just one figure in the number representing the distance of the comet from the sun, and thus not only completely spoiled the result, but left concealed in his numbers the key which was to lay open his forgery long after he should be dead.—SIMON NEWCOMB, in *Harper's Magazine for June.*

THE TOTAL ECLIPSE OF THE SUN.

On the 29th of July next a total eclipse of the sun takes place under such circumstances as to present opportunities that occur scarcely once in a generation for the study of some of the most interesting phenomena with which astronomers have to do. The path of the totality of this eclipse runs diagonally across the center of the United States from Montana to Texas, and is somewhere about 140 miles wide. Many of the best points for observing the eclipse are therefore directly accessible by railroad and several expeditions might be sent out fully equipped to as many different points, without spending so much money upon them as it would ordinarily take to equip a single expedition to a more distant point.

Recent discoveries have rendered it probable that most of the meteorological changes upon this planet are caused by events taking place upon the sun, and many questions relating to the physical constitution of that orb and the changes there taking place can only be studied during a total eclipse. It is said by Admiral Rodgers, of the Naval Observatory, that the sum of the opportunities which all the astronomers of the world can get for observing such eclipses does not exceed five or six hours in a century, and it is therefore important that every advantage should be taken of the very favorable conditions for observation under which the present eclipse occurs. All the principal European governments recognize the importance of studying the phenomena attendant upon the total eclipses, and send out costly expeditions, even to the antipodes when necessary, for this purpose, and there is no doubt that there is a general impression abroad that our government would make ample provision for the study of a matter of such general interest, that is visible almost exclusively within our borders, or the different foreign governments would no doubt be preparing to organize expeditions for observation on our territory. Our government, however, has so far done nothing, and it is possible that one of the best opportunities that may occur in many years for the study of solar phenomena may pass away without any advantage being taken of it.

The Naval Observatory is awake to the importance of the occasion and has asked Congress for an appropriation of $8,000, for the purpose of sending off seven expeditions, two of which it is designed to send to Montana, two to Texas,

two to Colorado and one to Wyoming, each to consist of three astronomers. The sum asked for was simply to pay traveling expenses and the cost of transporting and setting up the instruments in their temporary observatories, nothing being requested for salaries, as the most eminent astronomers will gladly volunteer their services for such an important occasion.—*Scientific American.*

AGRICULTURE AND HORTICULTURE.

FOLIAGE PLANTS FOR WINDOW CULTURE.

BY MRS. R. B. E. MELROSE, MASS.

Premising that among the readers of the *Monthly* there are some who like to turn aside from the beaten track, wherein grow Callas, Geraniums, Abutilons, &c., to "rarer fields and pastures new," I give herewith a brief sketch of my success with some of the less commonly grown window plants. And for ease of culture and showiness of foliage, I consider the Croton at the head of the list. I have a Croton interruptum, which I bought of Mr. Saul one year ago last May, then a very small plant, and to-day it is thirty inches high by as many broad, finely branched and richly colored. I do not, however, think interruptum nearly as handsome as some of the others; indeed, pictum, though an old variety, is more showy. I have one of the last, which is very lovely, with its gold and crimson markings. Of the new varieties, Youngii, Veitchii and Undutaltum are splendid species. In my opinion the latter is the prettiest, though all are magnificent. Crotons require strong sunlight, and the warmest place at command. I shower mine daily with warm water, and keep them on the highest shelf; and they well repay this slight care with their brilliantly-colored leaves, more ornamental, I think, than flowers. Dracænas are also both ornamental and easy of culture, and give a nice look to a stand of plants. But for a north window, and a cooler location, I think Aspidistra variegata the finest thing I have ever tried. I have one that has over thirty of its long, broad, glossy leaves, from four to six inches across, each elegantly striped with white, and gracefully recurved. It is never troubled with insects of any sort, and ought to be more often seen than it is. It requires a liberal supply of water, both over the foliage and at the root. Of rarer plants, I have grown with good success Palms, Pandanus, Marantas, Tillandsia and Dieffenbachia maculata, the latter an especially fine, free-growing plant, with broad green leaves, prettily spotted with white. It is recommended for wardian cases, but I have had no trouble with it in my sitting-room. Of course these more delicate plants require thought and care in their treatment, but they amply repay the extra trouble by the elegant effect they give to a stand of blooming plants. I think we might grow many more of what are classed as

"stove" plants in our rooms, by proper attention to cleanliness, and moisture in the air. In addition to water on the stove, I keep large sponges, constantly wet, lying among my plants. I have, in this room, a Maiden-hair Fern, which has thrown up between thirty and forty fronds, some of them two feet high, and the mass more than that across.

I will stop to mention but one blooming plant, as this article is already too long. One year ago last spring, in looking over Mr. Saul's catalogue for something new for winter blooming, I came upon the Rogiera. I sent and got one by way of experiment. And I wish to testify my extreme satisfaction with this pretty, fragrant plant. The variety I had, bore pinkish-white flowers, in heads like the Bouvardia, only the clusters were three times as large, and the fragrance is peculiar and exquisite. In needs heat and sunshine, and grows freely without trouble.—*Gardener's Monthly.*

HOT WATER AS A RESTORATIVE FOR PLANTS.

M. Willermoz, in the French "Journal of the Society of Practical Horticulture," relates that plants in pots may be treated with hot water when out of health, the usual remedy for which has been repotting. He says that when ill health ensues from acid substances contained or generated in the soil and this is absorbed by the roots, it acts as a poison. The small roots are withered and cease their action, consequently the upper and younger shoots of the plant turn yellow, and the spots with which the leaves are covered indicate their morbid state. In such cases the usual remedy is to transplant into fresh soil, clean the pots carefully, secure good drainage, and often with the best results. But the experience of several years has proved with him the unfailing efficacy of the simpler treatment, which consists of watering abundantly with hot water at a temperature of about 145° Fahrenheit, having previously stirred the soil of the pots so far as might be done without injury to the roots. Water is then given until it runs freely from the pots. In his experiments the water first came out clear, afterwards it was sensibly tinged with brown, and gave an appreciable acid reaction. After this thorough washing the pots were kept warm. Next day the leaves of two Ficus elastica so treated ceased to droop, the spread of black spots on the leaves was arrested, and three days afterward, instead of dying, the plants had recovered their normal look of health. Very soon they made new roots, immediately followed by vigorous growth.

MARECHAL NIEL ROSE.

This magnificent rose is not so generally cultivated as it merits. In many gardens there is not a respectable looking plant of it to be found, and in others it is not grown at all—an omission for which nothing else can compensate. When grown in pots or restricted as a dwarf or standard among others in the open air

it has no chance of developing its true qualities, and those who only grow it in those ways may just as well not grow it at all. To grow it in all its magnificence it must be planted out in a greenhouse or conservatory, and the branches be allowed to grow to their fullest extent. It is then that armsfuls of splendid golden blooms are produced and their great loveliness is fully displayed.

There is no plant in existence that will produce such a quantity of valuable flowers as a Marechal Niel rose, properly grown—and by growing it properly I do not mean that great attention must be paid to it; this it does not require. No plant under glass requires less attention, but what it does have must be of the proper kind. I think there are only two important points in the cultivation of this rose which must have the best attention: the one is give it plenty of nourishment at the root, and the other is to let the branches extend as much as possible, or at least convenient. A very favorable position is not necessary to its well-being. Back walls and low walls are positions where it will thrive. It may also be grown upon pillars or on roofs, but here it is then liable to shade plants underneath.—*Journal of Horticulture.*

MISCELLANY.

EXPENSE OF A TRIP ABROAD.

Since my return from Europe a large number of persons who contemplate a visit to the Paris Exhibition during the present year have desired me to give them some idea of the probable cost of the journey. To each one a uniform reply has been given, and the first words were, "You can make it cost just what, in reason, you like." And it is so. A man can spend a $1,000 in a month's travel, and another can suit himself just as well for one-fifth the money. My own experience, based on a ten day's visit to Paris during the Exposition of 1867, is that you can live remarkably cheap in that delightful city. During my visit in January last to the capital of France, I was careful to inquire as to the probability of an increase in hotel rates. The answer was there will be none. The Grand Hotel Bristol is a magnificent house in every respect, and for such a place the charges are remarkably reasonable. At that place a handsomely furnished, well-lighted room cost me six francs, $1.20 per day, and a dinner, including *vin ordinaire*, a similar amount. But, as in London, the better plan is to take your meals out, as the French people generally do. For ten francs (2) per day a man can live well. But to give a clearer idea of the total cost of such a journey, it may be as well to start out with the theory that we propose to be absent two months or sixty days. Eighteen days of this will be upon the ocean and for the round trip the cost need not be more than $120. On arrival at Liverpool, the docks and other places of interest have to be seen, which will occupy two days, the cost of living per day

being ten shillings, with four shillings added for omnibus and cab fares, $7 ; from Liverpool to Manchester, where two more days are spent at the same rate; then directly to London, the fare being $5, occupying a portion of one day. In London, there is a multitude of sights of interest to be looked up. There is the Crystal Palace, British Museum, Alexandra Park, Zoological Gardens, National Gallery, House of Parliament, the Tower of London, etc. Here, to do the thing up in any kind of a way, a sojourn of at least ten days should be made. This involves an expense of $30 for living, (it can be done for less, and well done too), and an additional $7.50 for omnibus hire. Then comes the trip to Paris. The return ticket from London to Paris will be, in American money, $18.75, and which is available for one month. The journey to Paris usually occupies from ten to eleven hours, so that one full day may be allowed in going and coming. Then a stay of fifteen days should be made in Paris, and the visitor, if he be prudent, can do admirably as far as lodging and living upon $2.75 per day, or $41.25; and adding to this ten days to the Exhibition, one franc each time, brings $3.25, with $10 added for conveyances, brings Paris to cost $53.25. During this time, if disposed, a trip can be made to Geneva Lake at a cost of $15. This brings us back to London, with eleven days to spare. A trip to the Isle of Wight, a run to Scotland, and thence down through Ireland, joining the steamer at Queenstown, can be easily done at an average cost of $7 per day—a total of $77—and then we find ourselves on board the steamer again, without anything further to pay than the stewards. This brings a total of $340, and allowing the extravagant sum of $60 for waiters, etc., the grand result is $400 for a sixty days' journey. This estimate is put at top figures, so that there shall be nothing ridiculous in its appearance ; but your readers may rest perfectly satisfied that a trip to Paris, properly managed, and an absence from home of sixty days need not cost any single individual more than $340.—*Cor. Providence Journal.*

THE MICROPHONE.

A paper lately read before the Royal Society announces the invention by Prof. Hughes of this astonishing instrument or apparatus, which opens to our ears a universe of sounds hitherto inaudible—just as the microscope revealed a world of minute life and structure unknown before. Like Mr. Edison, Prof Hughes was one day employing the telephone for various acoustic experiments. He wished to investigate the effect of sonorous vibrations upon the electrical behavior of conductors, led to this idea by the way in which selenium is known to become electrically affected by light, and also by the researches of Sir William Thompson upon the electrical conduct of strained wires. The Professor had a stretched wire on his telephonic circuit, and, though he talked and plucked at it, no effect followed until it broke. At that moment the telephone uttered a sort of "shh," which was very curious. He placed the broken ends together under a weight, and obtained again faint sounds, which were improved when the wires were connected by iron nails, or a steel watch chain—the more pieces and more

diverse in substance from the conductor seemingly the better. Experimenting still further with his broken circuit, especially in the direction of this whisper from Science about "more pieces," he found metallic powder or fine metal filings wonderfully augment the power of transmitting sounds; while shot, in a bright condition, platinum, carbon, and mercury also gave good results, particularly the last. Following up this clew, Prof. Hughes hit upon a plan of suspending finely divided mercury in a stick of charcoal by heating the latter and plunging it into quicksilver, whereupon the charcoal becomes infiltrated with the mercury in minutest but continuous particles Inserting a "transmitter" of this sort in his circuit, an absolutely amazing sensitiveness to sound, as well as power of conveying it with utmost fidelity, was displayed by the apparatus. A touch of the finger on the vibrating plate was conducted to the speaking end in volume of vibration like the rustle of a forest; the stroking of a camel's-hair brush on a card was magnified into the sound of a loud whisper; the beating of a pulse or the tick of a watch was found to pass with perfect clearness through a resistance representing a hundred miles of space; and, when a fly happened to walk over the plate, the tramp of its feet was most distinctly caught, like that of some six-legged horse trotting, and it was, moreover, heard to trumpet from its raised proboscis like an elephant in an India jungle. Sounds, in fact, totally inaudible before to the human ears were arrested and reported by this simple and accidental expedient of interrupting the electrical circuit with a finely divided conducting material. There is almost no doubt that the perfected microphone will convey to us that hidden ripple of the sap rising in growing trees and plants, which Humboldt said might be a continuous melody in the auditory organs of earth's smallest creatures.—*From London Telegraph.*

TREATMENT OF THE APPARENTLY DROWNED.

Dr. Howard, of New York, recently gave a demonstration of his method of treating the apparently drowned, at the Receiving House of the Royal Humane Society at Hyde Park, London. In the treatment recommended by Dr. Howard the patient is stripped to the waist and placed on his stomach, with his clothes or a hard pillow underneath it, so that the stomach and lungs become the highest part of the body. One hand is then placed over the stomach and another on the back, and, by using pressure, any fluid which is in the stomach is ejected. Having got rid of the water the patient is instantly turned upon his back, his clothes or a firm pillow are placed under it, so as to make the pit of the stomach the highest point, and his tongue is drawn out and held at one side of the mouth by a piece of cotton cloth. The arms are next seized at the wrists, drawn backward, and tied across behind the head. After this the operator stands over the patient, and placing his thumbs on the intercostal spaces on either side, proceeds to use pressure, the effect of which is to empty the lungs of a portion of the air contained in them; the hands are suddenly withdrawn, creating a compulsory inspiration. This process is to be carried on till animation is restored.—*Louisville Medical News.*

BOOK REVIEWS.

Current Discussion. A Collection from the Chief English Essays on the Questions of the Times. Edited by Edward L. Burlingame. Vol. II, *Questions of Belief.* N. Y., G. P. Putnam's Sons, 1878. For sale by Matt. Foster & Co., $1.50.

The present volume contains "The Soul and Future Life," by Frederic Harrison, "A Modern Symposium," at which R. H. Hutton, Professor Huxley, Lord Blachford, Hon. Roden Noel, Lord Selborne, W. R. Greg, Rev. Baldwin Brown and Dr. W. G. Ward discuss and pretty effectually demolish Mr. Harrison. Another "Modern Symposium," at which the same gentlemen and one or two other prominent writers and thinkers discuss "The influences upon morality of a decline in religious beliefs;" "The course of Modern thought," by G. H. Lewes. "The Condition and Prospects of the Church of England," by Thomas Hughes, and an essay upon "Is Life Worth Living ?" by W. H. Mallock.

All of the above subjects are, as the mere names of the writers assure the reader beforehand, treated ably and comprehensively. For want of space we will only refer to the first essay and the replies to it.

Mr. Harrison, with a great show of fairness and toleration, sets forth the position of the Positivists, who reject all hypotheses and accept nothing which cannot be proven, contemning with equal decisiveness the methods of the Materialists and of those who regard the human soul as an "immaterial entity temporarily indwelling in man's body," and erecting between the two a structure which satisfies neither. To give an idea of his position we quote a few lines:

"By a vast accumulation of proof, positive thought has at last established a distinct correspondence between every process of thought or feeling and some corporeal phenomenon. * * * To positive methods every fact of thinking reveals itself as having functional relations with molecular change. * * * Hence we have established an organic correspondence in all manifestations of human life. To think requires a corresponding adjustment of molecular activity. To feel emotion implies nervous organs of feeling. To will implies vital cerebral hemispheres. Observation, reflection, memory, imagination, judgment, have all been analyzed out, till they stand forth as functions of living organs in given conditions of the organism, that is, in a particular environment. * * * But complex as it is, there is no confusion in this whole when conceived by positive methods. No rational thinker now pretends that imagination *is* simply the vibration of a particular fiber. No man can *explain* volition by purely anatomical study. * * * All the spheres of human life are logically separable, though they are organically inter-dependent. * * * The consensus of the human faculties which *we* call the soul, comprises all sides of human nature according to our homogeneous theory."

Thus repudiating at once materialism and faith, and discarding the exploded errors of materialists and spiritualists (meaning, we suppose, those "that have not

seen and yet have believed"), he asserts that the spiritual functions of the soul are positive phenomena, and better satisfied by philosophic and historic answers than by "naked figments." This is as near as we can find out what Mr. Harrison regards as the soul, and we are almost as much in the dark as to his views of the future life. He regards it as selfishness to strive on this earth for Heaven, just for our own gratification and happiness there, and thinks that to so live that there will remain behind us a "permanence of the activities which give others happiness," is better than a future life of "ceaseless psalmody."

As we have above suggested, Mr. Harrison is, at the symposium which follows his essay, very severely handled, both by materialists and spiritualists, and it is well worth any man's while to read carefully this whole discussion as well as those which follow.

This "Current Discussion" series is a valuable and important contribution to literature, and the Putnams are to be thanked for bringing it together in so convenient and handsome a shape; albeit a little closer proof-reading would not be amiss.

The Elements of Rhetoric, by James DeMille, M. A. New York, Harper & Brother, 1878. For sale by Matt. Foster & Co. $1.40

No matter how naturally and easily men may write, they require careful training before they obtain the best power of expression. This is the field of Rhetoric and without its effective teachings composition would be monotonous and unattractive; with them it becomes harmonious, attractive in style and therefore more beneficial to the student and general reader. To those who have read Prof. DeMille's lighter works it is unnecessary to say that he has the elements of a teacher of rhetoric fully at his command, and to those who have not, the present work is abundant proof.

It is long since we have seen a work on Rhetoric, which, in skillful handling of the various departments of the subject and completeness as a whole, has so fully satisfied our idea. We have examined it with care and can find nothing essential to such a work, whether for school-boy or teacher, that is omitted, and nothing included which would, in our opinion, be better left out. It is just such a work as nearly all writers for the daily, weekly or monthly press frequently need at hand for reference or, at times, for guidance.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. IV, Nos. 1 and 2. Government Printing Office, 1878.

These Bulletins, published by the Interior Department and edited by Prof. F. V. Hayden, Geologist-in-charge, are becoming more and more interesting and are far more useful in their present form than when, as formerly, included with the formal reports and public documents. The above named numbers are full of valuable information to the naturalist, written by some of the most competent observers in the country if not in the world.

LAPARO—ELOTROTOMY. A substitute for the Cæsarean Section, by T. Gaillard Thomas, M. D. New York, Wm. Woods & Co., 1878. pp. 26. Octavo.

COMPARISON OF THE RESULT of the Cæsarean Section and Laparo—Electrotomy in New York. pp. 4. Octavo. D. Appleton & Co., N. Y.

THE INTRA-VENOUS INJECTION OF MILK as a substitute for the transfusion of blood. Illustrated. By T. Gaillard Thomas, M. D. New York, D. Appleton & Co. pp. 20. Octavo.

The above named pamphlets describe and illustrate fully the new and important operations introduced or revived by Professor Thomas of the New York College of Physicians and Surgeons, who has successfully performed both of them several times in New York City, and who, in these monograms, points out clearly their advantages. They should receive a wide circulation in the medical profession.

OUR REVENUE SYSTEM AND THE CIVIL SERVICE—Shall they be Reformed? By Abraham L. Earle, with preface by Prof. W. G. Sumner. pp. 52. 12 mo. For sale by Matt. Foster & Co. 25 cts.

PROTECTION AND REVENUE IN 1877, by Prof. Wm. G. Sumner of Yale College. pp. 38. 12 mo. For sale by Matt. Foster & Co. 25 cts.

FRANCE AND THE UNITED STATES; their present commercial relations considered with reference to a treaty of reciprocity, comprising papers by M. Menier, Leon Chotteau, Parke Godwin and J. S. Moore. 12 mo. pp. 44. For sale by Matt. Foster & Co. 20 cts.

All of the above belong to the series of Economic Monographs published for the New York Free Trade Club by G. P. Putnam's Sons, and are among the strongest and most instructive papers which have ever been published in favor of free trade. Every merchant, manufacturer and producer in the country should read them, and, whether convinced or not, most of them will at least be wiser and better informed than before.

PROCEEDINGS OF THE DAVENPORT (IOWA) ACADEMY OF NATURAL SCIENCES. Vol. III. Part. I. January, 1876 to June, 1877. pp. 148, Octavo. $3.

The Davenport Academy has acquired a national reputation for the enthusiasm and ability of its members, the thoroughness of their work and the remarkable success which has attended their labors. They have, since December, 1867, built up a fine library, a museum probably unequaled in the West, at least in archæological interest, and erected a handsome building commodious enough for both library and museum, besides containing a large lecture and other necessary rooms.

The present volume is handsomely printed and contains some very interesting and valuable papers on archæology, entomology and other departments of natural history. J. Duncan Putnam is the Corresponding Secretary and seems to be one of the leading spirits.

EDITORIAL NOTES.

THE marked feature of the past month to our scientifically inclined citizens was the visit to this city of the Kansas Academy of Science, whose proceedings have been fully reported by Professor Parker in this number of the REVIEW. The meeting was not only interesting in itself, but also cannot fail to have the effect of uniting more closely the scientific interests of Kansas and Missouri. We look forward with pleasant anticipations to the Tenth annual session of the Kansas Academy at Topeka, at which our Association is specially invited to be present.

AT the regular meeting of the Kansas City Academy of Science held at its rooms May 28, Professor Sheffield read a very interesting and instructive paper, upon "The Metric System," which was very well received and freely discussed.

This being the regular annual meeting, an election of officers was held, resulting in the reëlection of all the former incumbents without opposition, except in the case of Dr. Halley, who declined to serve longer as Treasurer, and whose place was filled by Dr. T. J. Eaton. Dr. Eaton was also replaced upon the Executive Committee.

THE Mennonite grass-burning stove is attracting much attention in Kansas and Nebraska and will, undoubtedly, be adopted largely in those portions of the West where wood and coal are scarce.

We also note that some enterprising citizen of Kansas, taking the hint, has invented a machine for compressing grass, weeds, &c., into convenient shape for fuel. If this proves successful it makes little difference whether the coal supply is exhausted in the next thousand years or not, for there will always be an abundant supply of weeds at all events.

WE are indebted to our old friend, Prof. John Kendrick, LL. D., for Cincinnati papers containing full reports of the Social Science Convention, held in that city the third week in May. It was a very interesting session and attended by some of the most intelligent and scientific men of the country, such as Professors Shaler, Wayland, Clark, Eddy, Pierce, Gen. Pope and many others of equal note. The papers read were mainly practical and valuable contributions to the literature of Sociology.

THE death of Prof. Joseph Henry, so long Secretary of the Smithsonian Institute, which occurred on the 13th of May, has been so widely commented upon by the scientific and daily press that nothing remains to be said by us.

His successor, Prof. Spencer F. Baird, has long been Assistant Secretary of the Institute, is in the prime of life and will doubtless conduct its affairs with the same interpretation of Smithson's will which enabled Prof. Henry to give the Smithsonian the world-wide reputation for successfully "increasing and diffusing useful knowledge among men," which it has attained.

THE verdict of the Coroner's Jury in the case of the men killed by the recent mill explosion at Minneapolis, confirms our theory of its cause. They "unanimously believe that the fire was generated between the mill stones, and, bursting into a blaze, ignited the flour dust in the conveyors and dust room, causing both to explode, jarring the dust of the whole mill into the air, which ignited and caused the first great explosion in the Washburn "A" mill; that the flames from the explosion, aided by the wind, were in a flash carried to the upper windows and dust spouts of the Diamond Mill, causing its explosion, which from the same causes was followed by the explosion of the Humboldt Mill, &c."

AMONG the witticisms in the Editor's Table of *Harper's Monthly* one of the best is that which attributes to Carthage, Mo. the headquarters of a Mississippi steamboat company, the joke being rather on the Editor than any-

body else, since Carthage is more than 300 miles from the Mississippi River, among the spurs of the Ozark Mountains.

Another equally as good was perpetrated by the *Christian Union* a few months since in editorially speaking of the Union Pacific R. R. as passing through Washington Territory! How would it do for these gentlemen to consult some modern geography about the "Far West?"

The Kansas City Academy of Science has probably secured a lecture by Dr. Heath, of Wyandotte, Kansas, who has lately returned on a visit from his adopted home in South America, upon "The Antiquities of Peru." This will be a rich treat, as the Doctor was connected with the Orton expedition and has given much attention to the archæology of that country.

One of the most remarkable occurrences which has come under our observation lately is the disappearance of a locomotive and tender beneath the quicksands of Kiowa Creek, Colorado.

The circumstances are somewhat as follows; An eastern-bound freight train on the Kansas Pacific road, on the 21st of May, plunged at full speed into the above named creek, the bridge having been washed away by a flood. The current was so strong that loaded cars and iron parts of the locomotive were washed five miles down stream, while the locomotive and tender disappeared altogether and were not found for more than two weeks afterwards, though diligent and constant search was made with long iron rods and otherwise daily. They were finally discovered, it is reported, by means of a magnet, which was carried over the surface of the sand and was finally attracted by the hidden iron. They are fifteen feet below the sand and twenty-five feet down stream below the bridge. Specific gravity accounts for the sinking of the locomotive through the quicksands, but in our judgment the movement down stream can only be accounted for by supposing that the whole mass of sand in the bed of the stream was in motion, like a glacier, and that the combined weight of the sand and the force of the current were sufficient to force this ponderous mass of iron, weighing perhaps 25 tons, the distance of 25 feet from where it fell. It is calculated that water moving at a velocity of 3,600 feet an hour carries fine gravel and when moving at the rate of two miles carries coarse gravel and pebbles. Such being the case, a stream moving with a velocity of not less than five miles an hour in a bed of quicksand would doubtless move the whole mass with almost irresistible force. It must be remembered that nearly all of the time, the year round, the bed of the Kiowa is perfectly dry and that all the water that flows through it except during freshets, passes beneath the surface of the sand, and it is not unreasonable to suppose that the sand may thus be moved *en masse* when suddenly saturated by a swift and powerful stream. Doubtless the formation of the cañons of the plains may be, in part at least, accounted for in this way.

The frost and storms of May 1878 will cause it to be long remembered by agriculturists and meterologists, as well as by those who suffered in different portions of the country from the effects of its numerous tornadoes and cyclones.

We have received the following named New Exchanges since our last issue, viz:

The *Observatory*, edited by H. M. Christie, M. A., London. England. Devoted to Astronomy.

The *Polytechnic Review*, published in Philadelphia, and which will be fully noticed hereafter.

The *Chronoscope*, edited and published by Colonel Henry Inman, at Larned, Kansas.

The *Western Homestead*, published by W. S. Burke & Co., at Leavenworth, Kansas, made its second appearance the first of this month. It is a handsome folio of 32 pages, devoted to general literature and fully illustrated, It is attractive in appearance and interesting in contents. Price, $2 per annum.

The American Antiquarian, edited by Rev. Stephen D. Peet, Ashtabula, O., Vol. 1. No. 1, octavo, 60 pages. This is a handsome quarterly, devoted to Early American History, Ethnology and Archæology. Its editor Dr. Peet, has long been recognized as one of the best authorities in the country on archæ-

ology, and he will doubtless soon place his periodical high among works of this class. Price, $2.00 per annum.

NOTES ON THE JUNE PERIODICALS.

One of the most interesting articles in *Popular Science Monthly* for June is that upon "The Age of Gymnastics," by Dr. F. L. Oswald, being a glowing description and eulogy of the the physical culture of the Greeks.

CLEMENS HERSCHEL, C. E., concludes in the *Journal of the Franklin Institute*, very valuable paper upon "The Erosive and Abrading Power of Water upon the Sides and Bottoms of rivers." Just at this time the threatening aspect of the Missouri river renders such reading peculiarly appropriate.

Among the many good things in the *Atlantic* for June we think the "Imaginary Dialogue on Decorative Art," between Socrates and Decalcomanias, by John Trowbridge, one of the best. It is aimed at one of the latest follies of the times and is sarcastic without malice and witty without effort.

THE *Library Table* has been increased in size and decreased in price. We regard this one of the best and most reliable critical periodicals in the country, and as such an excellent guide to those building up libraries.

THE *Botanical Gazette* for June '78, contains among other appropriate things, an article by Prof. Broadhead, of Pleasant Hill, Missouri, upon the Distribution of certain plants in Missouri. It is a useful and well edited periodical, and is published at Logansport, Ind. Price, $1.00 per annum.

UNDER the head of "Mining News," the *Engineering and Mining Journal* devotes a chapter in nearly every issue to the progress of the lead and zinc interests in Missouri and Southwestern Kansas. This is a new feature and gives those regions a prominence in the minds of Eastern capitalists which they have not hitherto possessed.

APPLETON'S *Journal* for June has an article by P. D. Hay, upon "South Carolina Relics," and one by H. W. Raymond upon the "Saalburg Ruins," both of which are interesting to scientific readers from the nearness with which they border upon archæology.

The International Review for June contains a very instructive article by Froude upon "Science and Theology, Ancient and Modern." Also a dual one upon "The Bible" of which Phillip Schaff contributes one part, entitled "Egyptology and the Bible," and Rev. Lyman Abbott the other on "The Gospel According to St. John."

Capt. Eads contributes to *Van Nostrand's Engineering Magazine* for June, a very complete and interesting article upon "The Improvement of St. John's River, Florida." Besides its usual quota of technical articles this number contains a full account of "The Obelisks, their Purpose, Proportions, Material and Position."

Judge E. D. Parsons, late of this city, now of Colorado Springs, Colorado, has published an enthusiastic description, in pamphlet shape, of the prairies of Kansas and the beauties and wealth of the Rocky Mountains, entitled, "Rambles in the Great Kansas Valley and Eastern Colorado." It is well written, and, while lavish in its praises of the region he describes, does no more than even-handed justice to them.

THE Smithsonian Institute sends out a circular asking for information of all kinds bearing upon American Archæology, to be used in an exhaustive work upon that subject. Everything will be acceptable, whether reports of explorations, of earthworks, lists of American antiquities in collections or otherwise, or contributions of specimens of aboriginal art. Address, Hon. Spencer F. Baird, Secretary.

The Peterson's have just published one of Mrs. Burnett's earlier novels entitled "*Miss Crespigny*." While lacking some of the strength of her later works, it is a pleasure to read it on account of its simple, honest, hearty style—one volume, paper, 50 cents.

Pettingill's *Newspaper Directory* for 1878, is a handsome octavo volume, and shows what a large business can be built up in a comparatively short time by tact and industry alone.

OUR readers will please observe that there are two pages extra of reading this month.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. JULY, 1878. NO. 4.

ASTRONOMY.

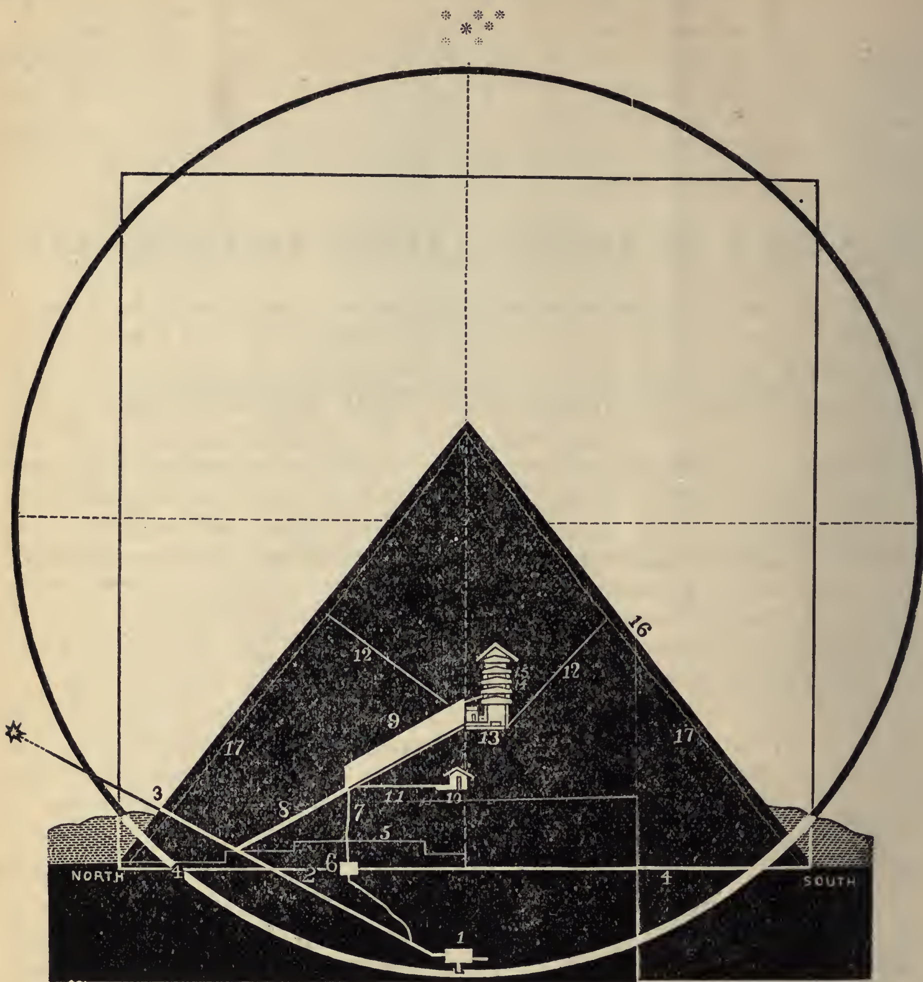
THE GREAT PYRAMID AND ITS SYMBOLISMS.

BY REV. JAMES FRENCH, DENVER, COLORADO.

(Article II.)

Magnitude has been supposed to constitute the distinguishing characteristics of the Great Pyramid of Cheops. We concede all that is demanded relating to its immensity. We admit that the character of the ancient Egyptians was marked with a veneration for huge proportions and prodigality of labor, without regard to either taste or beauty. We read these traits of their character not only in their many pyramids, but also in their sculpture of Ramases, the Sphynx, Cleopatra's Needle, and other relics of antiquity. And it is only in this *one* monumental pillar, which is the climax of all others in the attainment of what is superlatively vast, that we claim anything remarkably great in any other sense.

All of the many other pyramids are as destitute of science and symbolisms as images are destitute of vitality. They are mere lifeless imitations. The only attempt at imitation in the interior arrangements of any of the other pyramids, is in the descending passage to the "under world," and this was without any apparent discovery on their part of the lessons symbolized thereby in the original. This will appear on comparing a section of each of the second and third pyramids of the Jeezeh group with the first. (See figures.)



PYR-MET or PYRAMID.

1. Lower chamber. 2. Descending passage. 3. Entrance. 4. Natural rock platform. 5. Natural rock elevation. 6. Cavern. 7. Well hole. 8. Ascending passage. 9. Great Gallery, 10. Queen's Chamber. 11. Passage from the Great Gallery to Queen's Chamber. 12. Passage for ventilation. 13. King's Chamber. 14,15. Small apartments above King's Chamber. 16. Outer surface with casing. 17. Outer surface with casing removed.

SECOND PYRAMID.

THIRD PYRAMID.

To have imitated the ascending and horizontal avenues, with the rooms to which they approached (so prominent now in the first or great pyramid), would have been impossible; for they were then hermetically sealed. We now call attention to the pyramid scale of linear measure, in inches, along the interior avenues, where each inch is sub-divided with microscopic exactness, into fractions which are decimals, and add,

PROBLEM V. *The Pyramid inch is unparalleled in its fitness as a universal standard of linear measure.*

This statement accords fully with high scientific authority, as we have already shown. When the French government proposed to initiate a new metrical system which should be uniform, simple and exact, commissioners were appointed who first considered the question, *What shall be the unit of linear measure?* They were unanimous in deciding that it should be a natural and not an arbitrary standard. We admit the wisdom and propriety of this decision, and we can show that the pyramid inch approximates nearer to this qualification than any other standard ever proposed. It is natural because it is earth-commensurate. It is the one-five-hundred-millionth of the earth's polar diameter. It is simple because easily adjusted to the different measures of different countries. It differs from one inch only to the extent of .001 part, or one inch in a thousand. The French attempted to determine a natural standard and failed by $\frac{1}{5400}$ part in each meter. Hence they have now no natural standard. Shall we follow them in an admitted error which conflicts with their first principles adopted in initiating their system? Why should we when a simple, more correct, more natural one, and one much more easily adjusted to existing systems is in existence, handed down to us from the ages? Sir John Herschel says that the superficial curved meter of the French "was not a blunder only; it was a sin against geometrical simplicity."

When Edward II, A. D. 1324, decreed that three barley-corns, sound and dry, should constitute an inch, he was not endeavoring to change this measure, but to conform it to what he considered a standard more natural. But his standard was objectionable because changeable and unreliable; three barley-corns on King Edward's premises would be plumper and larger than an equal number of grains on poorer soil, or on land cultivated with less care. Hence the standard proposed was indefinite and never came into general practical use, although it long held its place in our school arithmetics. The pendulum system discussed by the French commissioners before the adoption of the meter, was rejected for similar reasons. It would vary with altitudes, latitudes and climate.

There is the same objection to Hon. Alexander H. Stephens' hair standard now before Congress. While it is simple enough, he omits to tell us what kind of hairs he would have us adopt, whether camel's hairs or horse hairs, fine hairs or coarse hairs. It gives us no intelligible starting point. A standard that is indefinite is equivalent to no standard, and ought not to be adopted by any nation—much less should it be recommended to become universal. It could never give satisfaction because definiteness is essential to a knowledge of correct-

ness. And it must be definite also in order to be commensurate. As has been suggested by the writer on weights and measures (in the new American Cyclopædia,) let the British inch and the American inch (which already varies a little from the one from which it was copied,) be lengthened to about half the width of a very fine hair longer than the present standard, so as to correspond with the exact one-five-hundred-millionth of the earth's polar axis; and then we will have our ideal of perfection. Then we will have a natural unchangeable standard wonderfully commensurate in its millions as well as in its units with the geographical and astronomical distances computed by it. There is another grave objection to the French system which has hardly been named. The *British-French* meter contains 39.37079 inches, while the *American-French* meter contains only 39.37068 inches. This difference between these standards of two nations so allied in language and nationality, would constantly work confusion of the most inextricable kind, were both of these kindred nations to unite in adopting the French system. If we are to have a world's standard, in this age of scientific attainments, let it be the best possible. At least let it have the merits of approximate unchangeable exactness. Then it will commend itself.

PROBLEM VI. *The Pyramidal metrical system as a whole presents unparalleled claims for universal adoption.*

1st. *It is founded on the most natural and most advanced scientific principles.* It is the *ne plus ultra* and actually approximates perfection.

As we revere the Bible because it contains a perfect standard of morality, and not this perfect standard because found in the Bible, (see Matthew 22 : 40) so we recommend the pyramidal metrical system, not because found in the pyramid, but for its own intrinsic merit; because we find in it the most convenient, the most simple, the most natural, the most exact standard in existence; a standard which has been recommended by advanced scientists, as their ideal of perfection, without reference to the pyramid; a standard upon which the wonderful ingenuity of man has not been able to improve.

2d. *Its location is central.*

We have business centers, and population centers, and geographical centers. It is claimed that the pyramid is located at that point on the globe which would be the most convenient meeting place on the earth for all the people of the two continents. This is very generally conceded after careful examinations and comparisons. I do not know that a more central position, including average temperature, could be selected.

3d. *Its linear standard is founded on the earth's unchangeable axis of rotation.*

4th. *Its weight and capacity standards are founded on the specific gravity of the earth (or the whole earth's mean density) in connection with the linear standard.*

5th. *Its thermal standard is founded on the mean temperature of the earth, as marked and exhibited in its highly polished and ventilated chamber.*

6th. *Its time standard is founded on the precession of the equinoxes assisted by meridian observations combining a polar with an equatorial star.*

7th. *It is oriented so as to point exactly half way between the cardinal points of the compass; while its four faces look exactly East, West, North and South; and its apex points directly to Zenith.*

In a former article, we exhibited a practical squaring of the circle. We showed how John Taylor found *pi* (3.14159) in the pyramid. Now we present another method of finding this factor, of the circumference of a circle.

PROBLEM VII. *The area of a right section of the Pyramid is to the area of the base, as one is to pi.*

$\triangle : \square :: 1 : 3.14159$. To obtain the area of a right section we multiply the height by half the base, thus: 5813x4565.15=26539251.5. To obtain the area of the base we square one side, thus: 9131x9131=83375161. The proportion then stands thus: 26539251 : 5 : 83375161 : : 1 : 3.14154. The variation in the last fractional figure is only the half of a ten thousandth part of an inch, and as near exact as possible when the first measurements extend only to tenths of an inch. Scientific authorities tell us that no mathematical problem ever excited so great interest as the one just practically demonstrated for the second time, by a proportion in areas, as before by a proportion in lines.

Archimedes is reported as being the first among the ancients who made any approach toward the practical squaring of the circle. By inscribing and circumscribing a polygon of ninety-six sides, he discovered that a circle of 4.970 feet in diameter would have a circumference lying between 15,610 feet and 15,620 feet. This was as near as that most ingenious inventor of ancient times could arrive at it. Had he known the method of obtaining *pi*, he would have arrived at the exact solution of his problem, by the rule of proportion, thus: As 1 is to 3.14159 : : 4.970. : 15613.75 feet.

PROBLEM VIII. *The length of the ante-chamber of the Pyramid multiplied by pi (3.14159) equals in inches the exact number of days and fractions of a day in a year.*

Here we have another circle where only the diameter is given in order to find it. On this circle we have the exact number of diurnal revolutions of the earth during one solar year, thus: 116.26 inches (length of ante-chamber) multiplied by (*pi*) 3.14159=365.2412534. It is worthy of notice that there is a regard to the decimal system in the proportions of circles and squares and areas to each other, as there is in the numbers. This circle is the exact one-hundredth part as large as the circle which equals the pyramid's square base, which we see in the figure, and where we first formed the division of a year into days.

It is also worthy of notice that the *pi* proportion is adhered to with unerring tenacity, without which the mathematical figures in the pyramid would be null and void. Prof. Smyth calls *pi* (or the value of a circumference in terms of a diameter of a circle,) "*the first key to the Pyramid, the key of pure mathematics.*" He says, "If the quantity *pi* is really found built into the great pyramid, with the exactness, as well as magnitude, characterizing the whole of that vast mass, it must have been the result either of some marvelous accident, or of some deep wisdom, and settled, determined purpose." *It certainly is found there*, and it not only ante-

dates its discovery by thousands of years, but it antedates also all known knowledge of the existence of such a mathematical quantity. Prof. Smyth thinks this implies a knowledge on the part of the architect, that this fundamental mathematical quantity would necessarily be understood without any explanatory inscriptions in our day when such progress in mechanic arts as we now see would be a matter of impossibility without an understanding of the numerical value and calculational quantity of this *pi* proportion.

PROBLEM IX. *The Pyramid gives us the exact number of years in the precessional period.*

We have already shown how by its star pointings the pyramid monumentally commemorated the beginning of the grand cycle of our solar system around Alcyone the brightest star of the beautiful Pleiades. This star, being on the celestial equator at that time, was never exactly in Zenith, but a little south of it It was exactly opposite (alpha) Draconis, the north star of that period, and with it formed the exact north and south line, by which the pyramid was oriented, before compasses were invented. Alcyone is a most wonderful star. It is said to be exactly in the great center of motion around which the universe of stars revolves. It shines with twelve thousand times the brightness of our sun, and in size it is proportionately large. If it were not so, it could not possess the attractive force sufficient to draw our whole so'ar system, with thousands of other starry systems, around it. Alcyone is so far away, that our orbit around it is more than one billion five hundred million times greater than our orbit around the sun. This is a distance so great, that if this wonderfully bright luminary had been annihilated seven hundred years ago we should still be beholding its light, which only just now has reached us. (See Ecce Cœlum).

Astronomers tell us that it takes 25,827 years for the multitude of the heavenly bodies which are attracted by it to perform their journey around it. *This is the precise duration of the precessional period.* The sun comes around to the equinoxes when the days and nights are equal, each year a little earlier than in the preceding year. This is called the precession of the equinoxes. Astronomers calculate the duration of the precessional period by dividing the number of degrees in a circle (360°) by 50.1″ or 50.2″, which is the space the equinoxes retrograde each year. They get by the first division 25,868 years, and by the second division 25,816 years. The pyramid comes between these two estimates and gives us 25,827 years, which agrees with 360° divided by the space referred to, corrected by extending the decimal fraction to two figures instead of one. But how does the pyramid arrive at this corrected estimate? It arrives at it, geometrically, by the famous forty-seventh proposition in Euclid, viz: the square of the hypothenuse of a right angle triangle equals the sum of the squares of the other two sides. In the pyramid's base we have two such triangles, and the length of each hypothenuse is 12.913+ inches, or 25.827 inches for both; which counting an inch for a year, is the exact length of the precessional period.

As we would naturally look for a symbol of a complete revolution on a circle,

instead of on a straight line, we are gratified with this additional symbol of this great cycle, on a circle of which the vertical height of the pyramid above the King's chamber is the radius. This was discovered by Prof. H. L. Smith, of Geneva, N. Y. This partial height is 4110.5 inches, which, doubled for a diameter, gives us 8221 inches. 8221 x (*pi*) 3.14159=25.827 inches as before. Now as the circumference of this circle corresponds in length with the perimeter of the square of this horizontal section of the pyramid, on its fiftieth course of masonry, we have the same number of inches again on this square, viz: 25.827 inches. So we have the duration of the precessional period marked in three different ways, viz: on lines, on a *square*, and on a *circle*, and all exactly correspond. This proves a most marvelous exactness attained by the builders of the pyramid in the designed thickness of each course of masonry. For if the rock had been put in at random without regard to exactness in the thickness of each course, it would have been impossible on the fiftieth course of masonry, where the King's chamber is located, to have obtained the exact length of radius necessary to obtain these figures.

Plato once said, "God geometrizes." Geology says, "nature geometrizes." This is a characteristic of the Great Pyramid which distinguishes it from all other Egyptian relics. It geometrizes. When we examine the movements of some complicated machinery, we notice that its parts, though of different sizes and measurements, are proportionate, corrected and exact; and we know that without these characteristics any machine would be worthless. The more we examine the varied figures and measurements of the Great Pyramid the more we perceive these peculiar distinguishing mechanical qualities; where variety and unity are harmoniously blended. And they suggest the idea of a oneness in the whole machinery of the revolving orbs, which implies a knowledge of their sizes, proportions, distances, and correlations to each other, on the part of the architect. Such knowledge at that period, we confess our utter inability to account for on any known natural principles. We have demonstrated problems which involve this knowledge. Will scientists please account for it, or convict us of fallacy in our demonstrations.

We expected to have been able in this article to have reached the inside symbolisms which are claimed to bear on chronology, future, as well as past; but our subject has expanded on our hands, and we must defer this for another occasion.

A TABLE OF MEASUREMENTS.

Area of square base of Great Pyramid	13.340	pyr. acres.
One pyramid acre equals	0.9992	British acres.
Ancient vertical height above pavement	5813.01	pyr. inches.
One pyramid inch equals	1.0001	British inch.
Ancient and present base-side socket length	9.131.05	pyr. inches.
Ancient and present base diagonal socket length	12.913.26	" "
Ancient inclined height at corners, pavement to apex	8.687.87	" "
Ancient inclined height at middle, pavement to apex	7.391.55	" "
Elevation of pavement base above the alluvial plain	1.500	" "
Elevation of pavement above average water level	1.750	" "
Elevation of pavement above Mediterranean sea level	2.580	" "

Ancient vertical height of apex above lowest room . . 7.015 " "
Ancient angle of side slope . . . . 51° 51′ 14.3″
Ancient angle of corner slope . . . . 41° 59′ 18.7″
Latitude . . . . 29° 58′ 51″
Solid contents of masonry. . . . . 10.340.000 pyr. cubits.
One pyramid cubit, 25 pyr. inches, or. . . . . 25.025 British inches.
The mouth of entrance passage . . . . 50 feet above pavement.
Entrance . . . . 25 feet east of center.
Doorway . . . . 47.3 high, 41.5 broad. dips at an angle of 26.3°.
Subterranean rock chamber . . . . . . 100 feet below the centre of the base.
Subterranean chamber is . . . . 46 feet long, and 28 feet broad.
Ascending passage leading from the entrance passage to the Grand Gallery, has its junction with the entrance passage at about 1,045 inches from its mouth.
This passage is . . . . . 47 inches in height, 41 inches in breadth, elevation 26°.
Southward up the first ascending passage to the commencement of the Grand · Gallery is. . . . . 1542 inches.
The floor length of Grand Gallery from north beginning to its southern termination is . . . . 1881-2 inches.
Height of Grand Gallery about . . . . 339 inches, or nearly 28 feet.
Height of the door at the north end of Grand Gallery is. . . . . . 53 inches.
Door at the south end leading to the ante-chamber . . . . 43½ inches.
From the beginning of Grand Gallery floor to the well called *Souterrain*, 33 inches.
The southern wall of Grand Gallery impends . . . . 1°.
Length of Grand Gallery midway between floor and roof. . . . 1878.4 inches.
Number of roof stones to this gallery . . . . 36.
Number of overlapping stones on the side walls . . . . 7.
Cubical contents of Grand Gallery . . . . 36,000,000 inches.
Strange exit from the upper corner of Grand Gallery . . . 28 feet above floor.
Length of short passage leading from Grand Gallery to the ante-chamber 52.19 in.
Length of ante-chamber is one-fiftieth of the pyramid's height . . 116.26 inches.
Breadth from east to west . . . . 65 inches.
The height . . . . 149 inches.
Wall of passage way between ante and King's chambers . . . 100 inches thick.
The King's chamber is . . . . . 412 in length, 206 in breadth, 230 in height.
King's chamber shielded from outside heat or cold by . . . 180 feet masonry.
Temperature of King's chamber 68° Fahrenheit or . . . 50° pyramid standard.
From base of pyramid to King's chamber 50 courses of masonry, to Queen's 25.
Wall courses of granite in King's chamber . . . . 5.
First four courses 4 feet high, 5th and lower one sinks one-tenth below the floor.
Outside measurement of Coffer, in King's chamber, length, 89.62; depth, 41.13; breadth, 38.61 inches.
Courses of masonry in the pyramid . . . . 206.

MARS' FAST MOON.

The periodic time of the inner satellite of Mars is only very little over seven hours, while the axial rotation of Mars itself requires about twenty-four hours. Now, this discrepancy is in apparent conflict with the nebular hypothesis, which assumes all the secondary bodies of a system to have been evolved from their primary at successive stages, with the velocity of the primary's surface at the time of their being dropped as rings of nebulous matter. But here is a planet's satel-

lite possessed of a velocity of revolution more than thrice as high as the velocity of axial rotation possessed by its primary. The problem, how to account for this accelerated movement of the inner Martial moon, has occupied the attention of astronomers since the discovery of Mars' satellites by Prof. Asaph Hall, a few months ago. The theory proposed by Prof. M. H. Doolittle, of the Coast Survey, appears to solve all the difficulties of the case. In three ways, according to Prof. Doolittle, the relative velocities of Mars and his moon might be modified by the impact of interstellar matter, or meteorites: 1. These bodies, by striking the satellite and forcing it to travel in a narrower orbit, its original absolute velocity continuing the same, would increase its relative velocity; 2. By striking the primary, they would increase its mass and its attraction on the satellite; 3. By increasing the mass of the primary and so reducing its absolute velocity they would make the relative velocity of the satellite higher.—*Pop. Sci. Monthly.*

POSITIONS OF PLANETS FOR JULY, 1878.

COMPUTED AT VASSAR COLLEGE.

On July 1 Mercury rises at 4h. 14m. A. M., and sets at 7h. 24m. P. M., keeping nearly the path of the sun, and of course it will be invisible. On July 31 Mercury rises at 7h. 1m, A. M., and sets at 8h. 20m. P. M.; it may perhaps be seen in the evening twilight some 7° south of the place of sunset.

Mercury and Mars are in conjunction on July 22; Mercury and Uranus on the 28th.

On July 1 Venus rises at 2h. 11m. A. M., and sets at 4h. 29m. P. M. On July 31 Venus rises at 2h. 25m. A. M., and sets at 5h. 18m. P. M.

Venus is far from us and small, but is very brilliant a few hours before sunrise.

On July 1 Mars rises at 6h. 38m. A. M., and sets at 9h. 10m. P. M. On the 31st Mars rises at 6h. 18m. A. M., and sets at 8h. 4m. P. M.

Mars and Mercury are in conjunction on July 22. Mercury is further north than Mars.

In July Jupiter will light up the evening sky. On July 1 this planet will rise at 9h. 8m. P. M., and set at 6h. 40m. the next day. On the 31st Jupiter will rise at 7 P. M., and set after 4 the next morning.

Jupiter's four moons revolve around the planet in so short a time that they are often lost to sight by passing across the planet in transit, by getting behind the planet as in occultations, and by passing into the shadow of Jupiter and becoming eclipsed.

The 1st satellite, or the one nearest to Jupiter, will be invisible for a time, from one or the other of these causes, during the evenings of July 8, 9, 16, 17, 23, 24, 25 and 31.

The 2d satellite is less exposed to these phenomena, but will be invisible for a time on the evenings of July 2, 9, 18 and 25.

The 3d satellite is large, and a glass of very small power will show it approach

ing the planet on the evening of the 11th, and passing in front of it, coming out from behind the planet early in the evening of the 22d, and disappearing by going into Jupiter's shadow late in the evening on the 29th.

The 4th satellite is rarely seen to make a transit, but on July 21 it may be seen in the evening to approach Jupiter, and a good glass will show that it enters upon the disk.

On July 1 Saturn rises at 11h. 40m. P. M., and sets at 11h. 33m. A. M. of the next day. On the 31st Saturn rises at 9h. 38m. P. M., and sets at 9h. 30m. A. M. of the next day.

Saturn will come into better and better position for evening observers. It can easily be recognized, as it is brighter than the stars around it, and rises but very little south of east.

Uranus rises on July 1 at 8h. 30m. A. M., and sets at 10h. 7m. P. M. On the 31st Uranus rises at 6h. 40m A. M., and sets at 8h. 13m. P. M.

Mercury and Uranus are in conjunction on the 28th, both of them near Regulus.

On July 1 Neptune rises at 1h. 5m. A. M., and sets at 2h. 39m. P. M. On the 31st Neptune rises at 11h. 4m. P. M., and sets at 40m. afternoon of the next day.

The year 1878 is the time for the recurrence of the minimum period of the sun spots, and since last November only six groups of these spots have been seen. On November 30 a very large double spot was seen, which was visible for the last time on December 3. On February 5, a chain of about twelve spots was seen near the center of the sun's disk. These were again observed on February 6 and 7. On March 5 two very small spots were seen passing off the disc of the sun. On March 15 three spots, one of them double, were seen between the center and edge of the sun, passing off. On the 16th these were again seen, but they were much fainter. On May 27 two large spots were visible. On the 29th they appeared as one single spot, and one group consisting of three individual spots. These were last seen on June 3, passing off the disc.—*Scientific American.*

GEOLOGY.

JACKSON COUNTY, MISSOURI—A FEW NOTES ON ITS GEOLOGY.

BY PROF. G. C. BROADHEAD, PLEASANT HILL, MO.

The general surface features of Jackson county are undulating and rolling. The rise from the lower plain or river bottom at Kansas City to the highest ridge near Lee's Summit is three hundred feet, or three hundred and forty feet to higher points in the southwest part of the county, and the difference of elevation of the plains in the northeast part of the county and the ridges in the southwest is about

three hundred and sixty feet. So, although the general surface is mainly undulating and rolling, the real difference of elevation and depression of surface is not great.

The upland surface formations of the Missouri river hills are of the age of the Bluff or Loess, and rest uncomformably upon the coal measures and are especially well developed at Kansas City. These clays are here of finely comminuted material, either sand or clay or a mingling of both, and extend over the bluffs as high up as two hundred feet or more above the ordinary stage of the Missouri river. Their lower beds often repose upon a mass of boulders and pebbles of granite, quartzite or queenstone, but not of very large size, showing that if of glacial origin they are near the southern limits of the ancient glaciers. Concretions of ironsand and calcareous concretions sometimes occur.

ROCK STRUCTURE.

The rocks of this county all belong to the coal measures and include about two hundred feet of Upper coal measures and a little over two hundred feet of the Middle measures. The lowest rock at Kansas City (No. 78 of general section of Upper coal measures) may be found at base of bluff between the bridge and Union depot. Its base is thirty feet above the base of Upper coal measures and is a well marked horizon, although its fossils are not more characteristic than those of some other beds. At Kansas City we find it represented by twenty feet eight inches of grayish limestone with one foot (No. 79) of oolitic limestone above it, and overlying the oolitic portion is four feet of nodular and shelly fucoidal limestones. These limestones (Nos. 78, 79 and 80) do not change in character, nor very materially in thickness in a long distance. We find them near the base of bluff at Rock creek, forming natural escarpments high in the bluffs of Little Blue and Cedar and on the highest knobs in the eastern part of the county near Lone Jack; in Lafayette county, near Chapel Hill and near Greenton. At Kansas City bridge the top of it is seven hundred and thirty-one feet above the sea, while at Pleasant Hill, Cass county, it is eight hundred and twenty-six feet above the sea, showing a dip northwest of ninety-five feet in about thirty miles, or three feet per mile. The dip west is about double, which would make real dip about north 25° west. Northwardly these limestones are easily recognized through the eastern part of Clay, the eastern part of Caldwell, the western part of Livingston and on up Grand river through Daviess into Harrison county. Near Bethany, in Harrison county, it extends across one of our ubiquitous Big creeks, forming quite a fall, from which circumstance I have in my reports often spoken of it as the Bethany Falls limestone. The oolitic bed is nearly everywhere present, but is rather thinly developed at Kansas City; at Pleasant Hill it is three or four feet thick; near Liberty Landing, in Clay county, it is thirteen inches thick; at Kirtley's quarry, near Mooresville, in Livingston county, eight and one-half feet in thickness, and several feet thick near Princeton, in Mercer county, which is its extreme northeast extension in Missouri. We thus find it very persistent in character for over a hundred miles. It is easily

worked, forming a beautiful and durable building rock, and has also the reputation of being a good fire rock.

A general section of the Jackson county rocks would be about as follows, using numbers of the general section:

NO.	THICKNESS.	DESCRIPTION.
100	3 ft	Ferruginous limestone, hard and in even layers.
99	30 ft	of sandy shales.
98	30 ft	Irregularly bedded gray limestone.
97	25 ft	Blue shales.
96	5 ft	Bluish gray limestone containing large *Producti.*
95 } 94 }	2 ft 9 in.	Blue and bituminous shales.
93	13 in.	Fossiliferous shales.
92	13 in.	Even bed of dark blue limestone.
91	5 ft	Blue shales. Fossils abundant in upper part.
90	9 ft	Grayish drab limestone, well characterized by containing *campophyllum torquium*, O. & S.
89	5 ft	Blue and olive shales.
88	2 ft	Nodular buff colored shales.
87b	3 ft	Irregularly bedded bluish drab limestone.
	10 in.	Shales not always present.
87a	18 ft	The upper 10½ feet beautifully oölitic, the lower 4½ feet of bluish drab or gray limestone. This limestone contains a great many beautiful fossils.
86	15 ft	Blue shales.
85d	14 in.	Blue limestone. Its most characteristic fossil a species of *archæocidaris.*
85c	2 ft 6 in.	Blue clay shales.
85b	4 in.	Rotten coal and shale—with cordailes.
85a	8 ft 8 in.	Dark blue silicious limestone with lenticular forms and concretions of dark colored chert. Fossils are numerous and very characteristic.
84	9 ft 4 in.	Fine grained dove colored limestone with splintery fractions and numerous specks of calc spar disseminated.
83b	5 in.	Shales.
83	3 ft 8 in.	Irregularly bedded bluish drab limestone—contains large nautilus.
82b	5 in.	Blue shales.
82	14 in.	Concretionary ash blue limestone contains *Rhynchonella*; *Rocky Montana.* Marcou.
81c	11 in.	Blue shales.
81b	1 ft 7 in.	Bituminous shales.
81a	2 ft	Clay shales.
80	4 ft	Nodular and shelly limestone. } Bethany Falls limestone.
79	1 ft	Oölitic limestone. } Bethany Falls limestone.
78	20 ft 8 in.	Mostly gray limestone. } Bethany Falls limestone.
77b	2 ft 2 in.	Blue clay shales.
77a	1 ft 4 in.	Bituminous shales.
76c	14 to 18 in.	Dull blue limestone.
76b	7 in.	Blue clay shales.
76a	6 in.	Concretionary limestone with many fossils.
75	2 ft	Blue clay shales.

74	6 ft		Gray and ferruginous limestone.
73	14 ft		Clay shales, sometimes replaced by a sandstone full of irregular winding cavities.
72	2 ft		Calcareous limestone and sandy limestone, full of beautiful fossils ; not distinguished from sandstone below it as we pass north.

BASE OF UPPER COAL MEASURE

71	1 ft		Blue and bituminous shales.
70		2 to 4 in.	Coal.
69	123 ft		Sandstone and shales, with about two thin layers of coal, a few bands of red shale near the upper part and occasional ochre concretions.
68	2 ft		Limestone with *Chaetetes milleporaceus*.
67	7 ft		Marly shales.
66	1 ft		Purple and red shales.
65	2 ft		Sandstone and shales.
64a	3 ft		Bituminous shales.
64	1 ft		Coal.
63	7 ft		Shales.
62	6 ft		Sandstone.
61	1 ft	7 in.	Dark shales and their concretionary bed of limestone.
60	7 ft	6 in.	Blue shales streaked with red.
59		6 in.	Coal.
58		3 in.	Dark shales.
57		6 in.	Fire clay.
56	3 ft		Sandy shales.
55	4 ft		Irregularly bedded limestone containing *Chaetetes Milleporaceus* and *Fusulina cylindrica*, Var. *robusta*.
54	6 ft		Drab, green and dark shales.
53	4 ft		Hard brown and gray sandstone.

MIDDLE COAL MEASURES.

The upper portion of the middle measures occupies the lower bluffs east of Independence. At Blue Mills Landing about eighty feet are exposed. At Sibley Landing we find about fifty-five feet of the middle part, and in the neighborhood there is found an eleven inch seam of coal. Another thin seam at a little lower horizon has also been reached in a well at Sibley. The same coal is also found in Sec. 21, T. 50, R. 29, and one foot in thickness. Its position is about thirty feet above the Lexington coal. At Napoleon, near the western line of Lafayette county, the Lexington coal should be about twenty feet below the water line. One mile west of Napoleon ten feet of No. 78 crowns a knob at an elevation of two hundred and seven feet above the river. At this place the Lexington coal may be found about twenty feet below the water line. Nos. 66 and 68 crop out at several places near Oak Grove, and one mile south we find

1	15 ft	Shales.
2	2 ft	Roughly bedded gray limestone, abounds in *Sp. lineatus*.
3	4 ft	Shales with red layers.
4		A few feet of thinly bedded limestone.

The shales and sandstones at the upper portion of the Middle coal measures, although occupying over a hundred feet in thickness in the eastern portion of

the county, do not contain any valuable beds of building rock. They do sometimes inclose thin layers of coal and occasional beds of ochre. Near Hunt' sMill the upper beds appear as follows:

1	14 ft	Limestone. Nos. 78 and 79, U. C. M.
2	27 ft	Including 5 feet of No. 74, U. C. M.
3		Outcrop of brown limestone.
4	16 ft	Shales.
5	2 ft	Red shales.

UPPER COAL MEASURES.

No. 72 lying at the base of the upper series I have nowhere found well developed in Jackson county, but is well developed at Pleasant Hill and near Harrisonville, and also in the northwestern part of Bates county. At Amos', in the southeastern part of Jackson, we have

1	15 ft	Gray limestone abounding in *Producti*, also contains a large *nautilus.* (?) Measures 1 foot across disc.
2	1 ft	Deep blue argillaceous limestone.
3	2 ft	Bituminous shales.
4	5 ft	Shales.
5	15 ft	Rough shelly limestone—No. 78.
6	.10 ft	Sandstone full of holes of winding cavities. This is generally replaced by shales.
7	10 ft	Shales.
8	2 ft	Even bedded blue limestone, jointed—No. 74.
9	2 ft	Bituminous shales.
10	20 ft	Shales with a calcareous bed in the lower part abounding in *Nuculana bellistriata*, *Myalina swallovii* and *Polyphemopsis peracuta.*

On the railroad a half mile north of Greenwood we have

1	8 ft	Gray limestone—No. 83.
2	9 ft	Blue and bituminous shales.
3	6 ft	Gray limestone, the lower part oölitic.
4	13 ft	Brittle drab limestone—No. 78.
5	1 ft 6 in.	Bituminous shales.
6	3 ft	Clay shales.
7	1 ft	Ferruginous limestone containing *Hemipronites crassus* and *Syringapoɪa multatenuata.*
8	1 ft	Calcareous and ferruginous shales abounding in *Spiriferina Kentuckensis*, *Spirifer* (*Martynia*) *planeconvexus*, *Sp. cameratus* and *Chonetes glabra.*
9		Brown ferruginous limestone.

On bluffs of Cedar creek, three miles north of Lee's Summit, we find the following series:

1		Brown limestone.
2	15 ft	Slope—an occasional outcrop of limestone appears.
3	25 ft	No rocks seen.
4	15 ft	Limestone—No. 78.
5	2 ft	Clay shales.
6	1 ft	Bituminous shales.
7	6 in.	Blue argillaceous shales.

8	1 ft		Nodular limestone and shales—No. 76.
9		8 in.	Limestone.
10	2 ft	6 in.	Blue shales.
11	4 ft		Ferruginous limestone—No. 74.

At Independence No. 98 appears to be the highest rock, and near the railroad depot we find No. 96. At Kansas City the beds are exposed from No. 78 near the water, to No. 100 on hill top. We will notice them as we ascend. No. 85 is rich in fossils, some of which are quite rare and often very well preserved. Among them I have observed very large and well preserved specimens of *Bellerophon percarinatus Con.*, larger than I have elsewhere seen. *Bell. crassus* Mk. is also found. This is the only stratum from which I have obtained *Myalina Kansasensis*, Sw. I have obtained it at Pleasant Hill, Cass county, and at Gallatin, in Daviess county, a hundred miles distant, at each place showing the well marked imbrications characteristic of the fossil, the absence of which in specimens found by others (which were only casts) caused a doubt to arise as to the species. Another very rare fossil found here is *Schizodus wheeleri* Sw., very abundant also in Daviess county. This fossil, also, I have not found in any other rocks. Other well marked fossils are *Yoldia subscitula*, *Solenomya* ———, *Edmondia reflexa*, *Aviculopecten occidentalis*, *Sh. Avic. carboniferous*, *St.*, *Aviculopinna Americanica* Mk. its lowest horizon. Good specimens of *Pinna peracuta* and *Myalina subquadrata* are also found, as well as *Platyostoma peoriensis* McC. and *Naticopsis altonensis*.

Probably the most interesting of the Kansas City group is No. 87, of which the middle ten feet is beautifully oölitic and contains a great many very pretty fossils. Over forty species have been recognized, among which I might name *Bellerophon Stevensanus* (?) *Bell Marcouanus*, *B. Kansasensis*, *Pleurotomaria turbiniformis*, *P. conoides*, *P. spironema*, *Aviculopecten carboniferous*, *Avic. providencis*, *Avic. occidentalis*, *Entolium aviculatum*, *Macrodon tenuistriata*, *Allorisma costata*, *Edmondia reflexa*, *Terebratula bovidens*, *Monotis gregaria*, *Eumicrotis Hawni*, *Allorisma costata*, *Myalina Swallovii*, *Productus symmetricus*.

A shaly bed sometimes occurs which abounds in *Spiriferina Kentuckensis* and remains of *Crinoidia*, including *Zeacrinus mucrospinus* and *Z. acanthophorus*. No. 90 affords a good building rock and abounds in fine specimens of *Campophyllum torquium* O. & S. Just beneath No. 96 and in shales (No. 94) occurs a very pretty *Conularia*, which in Missouri has thus far been only obtained from this horizon and at Kansas City. I have obtained the same fossil from upper coal measures of Montgomery county, Illinois. No. 96 is easily recognized by its peculiar type of large fossils. Similar species in this rock seem larger than where elsewhere found. *Producti* are abundant, also several species of *Bryozoa*. No. 98 forms rugged mural escarpments in the Kansas City bluffs. Brachiapod fossils are the most abundant. In my notes I have named *Syntrilasma hemiplicata* as one of the fossils found, but at many visits I have failed to find it; I therefore think it must be a mistake. *Syntrilasma hemiplicata* is abundant in No. 110, in Missouri bluff of Platte county, and in some beds at Eudora, Kansas. *Meekella*

striato-costata is sometimes abundant. That rare fossil and fine *Chonetes millepunctata* Mk. I have from Kansas City. The only other locality I know of is at Centralia, Illinois. Its exact horizon at Kansas City is unknown, but is probably No. 91.

MINERALS.

No important ores are formed in quantity. Zinc blende has been obtained in several places in the southern part of thecounty, but only in small quantity. *Barytes* (sulphate of Baryta) has been obtained from Nos. 74, 78 and 100. Handsome forms of calcites of the varieties nailhead spar, dogtooth spar and other forms have been obtained at Amos' quarry. Beautiful acicular crystals of arragonite I have also obtained from the same place.

THE ROSEDALE COAL VEIN.

Dr. J. Thorne sends the following item to the *Kansas City Journal:*

The Rolling Mill company at this place are now sinking a well for gas. The present depth is three hundred and forty-five feet. The following is the result thus far:

Surface dirt	23
Limestone	40
Soapstone	180
Limestone	8
Coal	3
Green shale	20
Black slate, Gas	6
Soapstone	20
Black slate, Gas	8
Green shale	20
Limestone	1
Coal	5
Soapstone	11

Thus we find a good deposit of coal three feet thick at a depth of two hundred and fifty one feet; at two hundred and seventy-four feet, gas with a pressure of seventy-five pounds to the inch. This burns with a clear flame, and is almost without smell. At three hundred feet we find more gas with a still heavier pressure; at three hundred and twenty-nine feet we have coal five feet thick; this is of good quality. You should remember that the well was started for gas; no coal was expected. The contractors, Swan Bros., are men of large experience in their line of business. They have the most complete and elaborate test machinery which science gives to determine the character of material they go through, and the facts and figures above given from the books of Mr. C. B. Swan are as reliable as any test can make them. Thus we have working beds of good coal eight feet in thickness within two miles of Kansas City.

—Geologists and botanists will be interested to hear of the publication of the third and concluding part of the work on the fossil plants of Switzerland by Professor Heer, the highest living authority on such subjects. This forms an appropriate continuation to the work on the fossil flora of the arctic regions by the same author. The fifth volume of the latter work is in press, and will contain an account of the fossil plants discovered in the Grinnell Land during the recent arctic expedition, and also the miocene flora of the Sachalin Island and the fossil plants of Nova Zembla.

—Recent investigations on the mean density of the earth, by Messrs, Cornu and Baille, show a value of 5.56—somewhat different from that which has hitherto been generally accepted.

CORRESPONDENCE.

SCIENCE LETTER.

PARIS, June 20, 1878.

Dr. du Saulle, of the Bicêtre hospital, estimates the number of epileptics in France at 40,000; one-tenth of these only are patients of asylums. Independent of these statistics, many families carefully conceal those of their members afflicted with the disease. As a general remark, an epileptic can be as intelligent and as reasonable as a person enjoying the most robust health. Not only is epilepsy not incompatible with the exercise of the intellectual faculties, but it has affected very great men. Julius Cæsar, Petrarch, Newton, Mahomet, Peter the Great and Moliere were epileptic. An occasional lapse of memory, the passing vertigo, alone betray the presence of the disease. The individual may be occupied with his ordinary affairs, enjoying apparently excellent health, when he suddenly turns pale, pauses a little, looks surprised, with eyes fixed, rests motionless from four to twelve seconds, heaves a sigh and finishes what he may have been speaking about; he has not fallen, has neither seen nor heard anything — he had simply absence of mind. At a whist party, a player suddenly drops the cards from his hands, and after a few seconds of immobility, resumes the game. Others may remain agitated and incoherent for hours. Dr. du Saulle draws attention to the disease from a medico-legal point of view, and asserts, the law very frequently punishes as criminals those who are the unconscious sufferers from epilepsy. A young man in a restaurant suddenly commences to whistle, undress and to brush his clothes—he is considered worthy of confinement. A lady distributes to the passers-by some money, her prayer book, her gloves, her umbrella, her bonnet—the crowd believes her to be drunk. Returning to consciousness, she seeks refuge in a cab. A philosopher rises from his work-table, and in the course of half an hour, makes and unmakes his bed; a millionaire solicits charity in the

street; a soldier carrying dispatches, suddenly unsheaths his sword and attacks all persons within his reach. It is while in this state of access, that the afflicted kill wives, children, and those most tenderly loved, and that hallucinations of a religious nature are most frequent. When epileptic attacks are permanent, there is less danger for society, as the patient must be confined; the "fury" stage is terrible to witness; the afflicted is at first sad, then gesticulates, foams at the mouth, threatens, yells, strikes and bites; attacks the first person within reach, or beats himself against a wall. The crisis terminated, extreme prostration ensues. There is a category of epileptics who are only eccentric, immoral, extravagant, or wicked at fixed epochs; who commit the same acts and obey the same impulses, as if set in motion by machinery. Alcoholic epilepsy is varied and irregular, and is recognized by hereditary attributes. Criminals and vagrants often simulate epilepsy; when the latter is real, the attacked invariably becomes pale and devoid of sensibility—indications that cannot be imitated; the eyes are convulsed up ward, the body is rigid as a bar of iron, and the teeth firmly clenched; foam comes to the lips, often stained with blood. Dr. du Saulle asserts, that epilepsy can be suspended, and the epileptic disarmed, by a bromide of potassium treatment. French juries are more and more attaching weight to medico-legal evidence, when in presence of a case of abnormal crime, and the accused possesses satisfactory antecedents.

A recent explosion of a fulminating factory in the most central part of Paris, naturally raises the question, "What is a fulminate, what is its chemical composition and explosive properties?" The first fulminate was prepared in 1774, by Bayen, an army apothecary, from mercury. In 1788 Berthollet obtained it from silver, and applied it to military purposes. But as the slightest shock or elevation of temperature caused it to explode, its use was limited to fire works. In 1800 Howard, mixing saltpeter with fulminate of mercury, obtained a practical detonating powder. Fulminate of mercury is prepared by adding nitric acid and alcohol to mercury, and heating the mixture in a vapor bath till yellow-white crystals are obtained. Fulminate of silver is similarly obtained, only silver replaces mercury. Both powders are very explosive; the slightest friction is dangerous, hence, why they are touched only with spoons made of paper, or the softest wood. Chemically, fulminate of mercury is a combination of cyanic acid and the protoxyd of that metal. How does it come that cyanic acid possesses so terrible an instability? Science cannot explain the promptness of decomposition; all that is certain is, that the elements of the acid, cyanogen and oxygen, are gaseous, and when the salt or powder decomposes, they liberate an enormous quantity of gas suddenly formed, the accompanying heat increasing the expansion. Common gunpowder is but an assemblage of kindred substances, which in decomposing are almost transformed totally into gas. Science cannot explain why the chlorates and picrates are equally as dangerous as the fulminates. To these must be added nitro-glycerine and dynamite, the latter being only nitro-glycerine diluted in an inert substance. These matters are more explosive than

gunpowder, and fulminate of mercury possesses the greatest shattering power of all. The latter is the material employed in those partially dangerous playthings, fulminating peas, that crack when walked upon; or detonating bombs, that explode when thrown against a wall or in a flag. The Cossack bombs, or common cracker of evening parties, consist of two narrow slips of parchment, between which is placed a morsel of the mercury, mixed with a few grains of sand or pounded glass; when the ends of the parchment are pulled in contrary directions the rubbing of the sand or glass against the fulminate provokes an explosion. The paper priming for children's pistols is merely a mixture of fulminate with with saltpeter or gunpowder dust, coated with gum to keep off damp and imprisoned between two atoms of paper. The capsules for rifles and fowling pieces, are similarly composed; the matters are made into a paste to allow of being worked; then passed though a riddle to break up the paste, and lastly agitated or whisked in a bottle till the paste divides itself into tiny balls of a determined size; these balls are dropped into trays containing each five hundred copper capsules, after which a globule of gum varnish follows, to protect the fulminate against humidity.

Dr. Fabre has investigated the allegation, that miners are peculiarly sufferers from anæmia, or impoverishment of the blood. In this disease the individual is pale-looking, not on account of the volume of the blood being diminished, but owing to a decrease in the number of the red globules of the blood, and which constitute the richness of that fluid. If miners be pale, observes Dr. Fabre, the cause is to be sought, not in anæmia, but in a diminution of the coloring pigment of the skin. In a coal mine, the quantity of oxygen is less, and of carbonic acid greater, than in the external atmosphere, but the toxical gases, owing to improved systems of ventilation, play no more a vitiated role. In the coal mines of Commentry, horses have been employed fifteen years, and no difference has been found in the globules of their blood, as compared with horses over ground. Dr. Fabre concludes that the volume of the red globules is smaller, and their appearance paler, in the case of miners, than with ordinary individuals. As to the longevity of miners, the Doctor states, that from among two thousand pitmen who had worked uninterruptedly from twenty to thirty years, fifty-two were above sixty years of age; eighty-eight between fifty and sixty, and one hundred and forty-seven between forty and fifty.

However, anæmia is a malady in a sense modern and peculiar to a town life. "Upon twelve individuals" observes a leading practitioner, "residents of a city, I find nine who are anæmical." In Paris, the favorite prescription with doctors for patients who "are out of sort," fatigued or suffering from depression, is bark, iron preparations, underdone beefsteaks and country air. The air of the fields is salubrious and a practical tonic. There is much truth in the remark, that if the rural population did not come, little by little, to renew that of the town, the denizens of the latter would die out, and cities become only vast cemeteries. Air is the best of aliments; it is the true *pabulum vitæ;* we choose our food, wine and

water, but for air, we have to accept it as it arrives. In cities, the quarters renowned for good air are eagerly sought by those who can afford it, many preferring that which is bracing. But the latter is not necessarily pure; the quantity is often confounded with the quality. Chemically, air is said to be composed of nitrogen, oxygen, a little carbonic acid and a trace of ammonia; philosophically, the composition includes a variety of additional matters, held in suspension, animated or inert. The atmosphere is a vast receptacle, where gases and every kind of light residues float, as grains of dust swim in water; there are the dead bodies of infusoria, dried pus, the pollen of flowers, and the germs or spores of epidemics. Now as the impurities of a stream fall little by little to the bottom, so the deleterious atoms in the air gravitate to inferior zones, where man, riveted to the soil, has incessantly to inhale them. Some of these substances are harmless, others poisonous and that can produce serious maladies. We unconsciously swallow millions of microscopic plants. The microscope has revealed in a single drop of water which had passed through a portion of the atmosphere, the presence of half a million of germs or spores.

In addition to these, there are the residues of our respiration, the impurities of our cutaneous secretions, and the remains of our dead cells. Ehrenberg has discovered in the air more than 200 different species of infusoria, the atmosphere of some rooms is impregnated with arsenical emanations; that of printing offices, auctionary and of sick chambers, with species of transparent and irregularly-shaped animacules. The "morning air" of a city is a museum of poisonous curiosities, caused by the dusting of houses and the cleansing of streets; happily our lungs are a capital filter, and arrest even matters too minute to be detected by the microscope. Pure air will not reflect a ray of light; expire across a ray of electric light, the latter will be cut as it were by a black space, as the expired air having been filtered by the lungs, contains no impurities, that is reflecting atoms. In pure air, putrefaction is impossible; it contains no fermentation germs; air in a chamber is chemically pure when after a few days of absolute calm, its suspended matters have subsided. In this condition, Tyndall says, substances will not decompose. The lungs receive daily 10,000 quarts of air; judge then the impurities that must pass through the cells, of the struggle between these foreign matters and the globules of the blood, to secure the oxygen. Now this struggle to acquire the requisite dose of oxygen to consume our food, represents all the difference between robust health and disease. The strong suffer least; but what benefit is the most substantial regimen, if good air, that is, the supply of oxygen, is wanting in the economy. What is gained by filling a furnace with fuel, if air be insufficient—if the stove cannot draw? No suitable supply of oxygen, no digestion; and no digestion, no assimilation of food is possible. Hence, why change of air frequently proves the best of medicines, and why a run to the seaside or a mountainous country restores a lost appetite. When a citizen enjoys a day's outing in the field, he returns home with the hunger of a wolf, and sleeps as sound as the blessed. Hence, too, the importance of holidays, of trips and of tours.

In cities, an elevated site is not necessarily a healthy one; the wind may waft across an over-populated quarter; generally a southwest position is to be preferred, as the air coming ocean-wards is purer than when it arrives from the northeast, over the continents. Again, sea air is exciting, and that of mountains tranquilizing; at the sea side a stony beach exercises a different influence from a sandy one.

Intense attention is given at present to the science of acoustics and electricity. The new concert hall at the exhibition, is a model, as respecting the laws of sound, and, as for electricity, not only are public buildings now illuminated with this agent, but also avenues and streets. At the present moment men are laying down wire in gutta percha tubing, to illuminate the Champs Elyseê and parts of the Bois de Boulogne for the 30th, by means of the electric light. M. Reyner has perfected an ordinary lamp for electricity, that contains the germs of a great innovation; it is equal in power to an ordinary Carcel lamp, and the difficulty has been conquered for its lighting; it divides the light, and can shade off rays for one or two rooms. Capt. Trére, of the navy, has invented an electric break, by means of which, on touching a button, either in his cabin or on the quarter-deck, he can instantly control the speed of the engines—the electric current commanding the valves. This is only an application of the new compressed air-break for railways, and which is becoming common in France. In running at full speed, the engine driver can, by touching a handle, bring the train to a sudden stop—the shock is next to insensible. Visitors crowd to study the apparatus in the exhibition, after being astonished at its application to the train that has conveyed them.

" ANTRUM. "

Editor Western Review:—A recent sad event has induced many persons to ask, "What is the antrum, and why and how is it subject to disease?" *Antrum* means a "cavern." In anatomy it applies to certain cavities in bones, the entrance to which is smaller than the interior. "*Antrum Highmorionum*" (so named from being discovered by Dr. Highmore) "is a deep cavity in the substance of the superior maxillary bone (the upper jaw) communicating with the middle meatus of the nose." It is lined by a prolongation of the mucous membrane which lines the cavities communicating with the nose. This "cavern" is situated from one-eighth to three-eighths of an inch above the extreme point of the fang of the second bicuspid and first molár teeth, the intervening bone being quite cellular.

Disease of the antrum may occnr from an injury to the cheek bone, or either of the teeth above named; possibly from some chronic affection of the nose. More frequently, however, it originates from one of these teeth becoming decayed and diseased at the root. When the peridontium (lining membrane of the tooth's socket) or the pulp of the tooth becomes ulcerated, and the pus is prevented from discharging through the pulp canal of the root, it will necessarily find vent in some direction; usually through the alveolar process and gum—forming an

alveolar abscess, ("gum boil.") Not infrequently, however, the inflammation and consequent pus find a more ready passage through the cellular tissue of the maxillary to the antrum. If confined to these parts any length of time necrosis (dead bone) follows, and sooner or later produces tumor or cancer. In the earlier stages of diseased antrum, especially when originating from a tooth, the treatment and cure is simple and comparatively painless. It is only necessary to have an opening to the cavity through the alveolus and maxillary, either by extracting the diseased tooth or by an artificial aperture. This passage must be kept open by means of *tents* until the disease is entirely eradicated and new and healthy tissue takes its place. The treatment consists in injecting the cavity with a mild antiseptic, thoroughly washing out all accumulation of decomposed substance, once or oftener every day, until healthy granulation is completely established.

Just here it is important to repeat, and urge upon the community, parents especially, the fact that the first molars of the permanent teeth come in when the child is *six years of age*. Also that, they are the most important in preserving the contour of the mouth, and in masticating the food. They are almost certain to begin to decay when the child is from eight to twelve years of age, and if not promptly filled are certain to give great pain and trouble. They should never be extracted while there is any possibility of saving them by suitable treatment and filling. Parties who have suffered have urged me to elucidate this subject, as a warning to intelligent people not to procrastinate the important matter of preserving the teeth. Nothing but prompt, constant and scientific attention will save them. Procrastination invariably increases expense and depreciates your teeth, health and beauty. A. H. TREGO, D. D. S.

INTERESTING NOTES ON FORMER CYCLONES IN WESTERN MISSOURI.

EDITOR OF WESTERN REVIEW OF SCIENCE: I have just read, with much interest, the article in the June number of your REVIEW on the Richmond cyclone. Pardon me for saying, in advance of what I wish to communicate in this letter, that it should be a matter of general regret that scientists employ the term Cyclone, when they have at hand so forcible and expressive a word as the Saxon, whirlwind—a word so intelligible to all classes of people, and which so admirably conveys the idea. It does not appear from your article what were the track and course of the whirlwind or tornado which passed over Richmond in 1869. My recollection is, that it was in June of that year. On the same day, in the evening, and I think closely contemporaneous with the storm at Richmond, a violent wind-storm, followed by hard rain, passed over Liberty, going from northwest to southeast. Whether the wind which passed over Liberty swept down the Missouri river and united with some other current to form the tornado at Richmond, or was the result of atmospheric disturbances at or near Richmond is, of course, with me a matter of conjecture.

There was a fearful wind, sometimes called the "whirlwind" or "great

hurricane," which passed about forty years ago over the Missouri river, near Blue Mills Landing, in Jackson county, into the river bottom of Clay county, between the bluff at Liberty Landing and the bluff at Missouri City, doing immense damage to the forests. The trees were so blown down that for years after, in the bottom below Liberty Landing, it was impossible to go through it on horseback. It became a lair for wolves and sport was had for a long time in hunting them. Probably this was more than forty years ago. It was long before my recollection, but when a child I often heard it spoken of. R. A. Neeley, who lives in this county, near Missouri City, could give you details. He has a very remarkable memory and retains old events with great freshness. I do not know enough about that wind to say whether it was a whirlwind or hurricane.

In 1844, the farthest point to which my recollection of meteorological events extends, a hurricane swept over the same territory as in the "great hurricane," but it was not so violent. I remember it distinctly. The facts within my knowledge and observation lead me to the conclusion that the area of country between the bluffs at Liberty Landing in this county, and Lexington, is subject peculiarly to violent winds, whirlwinds and hurricanes.

In 1862 or '63 a very violent wind swept over the northeast portion of this county, passing between where are now the villages of Kearney and Holt, and I have heard of violent winds since passing over the same line. But the winds that have swept over the northwest portion of Clay have never been so destructive as those over the southeast portion of it. Thinking that you will wish to continue your investigation of the whirlwind, I have deemed that the communication of the above facts to you might be of service in reference to the question of localities where they are likely to occur.

Very Respectfully, D. C. Allen.

Liberty, Clay Co., Mo.

KANSAS CITY INDUSTRIES.

This is the only place I have seen, the last six months, where nobody complains about hard times. Every body appears to thrive, and the city grows and prospers. It is probably due to the fact that it is mainly a market and shipping point for the necessities of life, such as grain, cattle, provisions, and clothing, while her manufacturing interests have not yet recovered from the measles, and, for that very reason, have not been affected by the maladies of dropsy, gout, and "katzenjammer," which distinguished the manufacturing centers and wings of this country. Still, there are some branches which exhibit much pluck and life.

Several coal companies have their headquarters here. The total in and out of coal last year amounted to 3,600,000 bushels. The companies are not a unit, and coal sells at eight to nine cents. Rusty coal, from Fort Scott, and the Joplin coal, the best of all, sell at from ten to eleven cents.

The Kansas City Rolling Mills, of Rosedale, use exclusively Joplin coal—that is, coal mined at Pittsburg and Carbon, on the Joplin railroad, in Crawford county, Kansas. The mills produced the last seven months 18,900 tons of rails.

They consumed, in making the same, 18,170 tons of Joplin coal, which much resembles Indiana block coal.

So far as her resources and local interests and influence may warrant it, her iron works and shops do and will do well. But she must beware not to repeat the great blunder of St. Louis. Competition runs so high that all out of place establishments must be brought to the fuel; generally the metal, too. The millions thrown away in Carondelet or South St. Louis, if applied to the improvement of the Missouri River transport between Kansas City and St Louis, would have secured the preponderence of St. Louis over Chicago in regard to shipments from this point.

The great iron manufacturing interests of St. Louis must needs locate upon Illinois coal; those of Kansas City upon Crawford and Cherokee county coal—near enough to benefit the great commercial interests of both. One sentence will explain the matter: No coal, no Pittsburg; no Pittsburg, no worthy competition. Several foundries and machine shops are doing well, and the building of new shops is contemplated.—*Correspondence of the Engineering and Mining Journal.*

METEOROLOGY.

A NEW VIEW OF THE WEATHER QUESTION.

BY ISAAC P. NOYES.

The following remarks are respectfully offered in the hope that they may tend to throw some light upon the further solution of the weather problem.

In connection with the facts and comments thereon, theories will be advanced on the basis of the facts as at present known to us, not with the idea that they will be new to the initiated, but rather with the hope that they may better serve the object of the article by drawing attention to this interesting problem, and in a general way reaching some minds that by other means might not be attracted to it.

The weather by many seems to be regarded as among those things that are "past finding out," yet it would seem that as familiar as the knowledge of natural phenomena is now to the world at large, it should no longer remain quite the great mystery that it has necessarily been in the past. The simple trouble in the past, in this department of science, was the want of the proper medium by which to collect the facts. This subject has had very earnest apostles, but what even can the most earnest devotee do when the very material on which he would construct his laws is beyond his reach. After much controversy on this subject and discussion by such men as Halley, Espy, Henry, Butler, Loomis and others, the great want which they labored for and knew to be absolutely necessary, was finally supplied by the United States Signal Bureau, under Gen. A. J. Myer, of the United States Army. Of course such a bureau has its enemies, and steps have at times even been taken to cripple its actions, and perhaps some would cut off all appropriations for it and leave it among the things of the past, but such a

course it is to be hoped will not be seriously thought of by any controlling element, at least so long as the general treasury can be made to meet the modest demands of so happy a combination of science and practibility. Only by such a large and simultaneous collection of daily facts as this office is year by year patiently collecting have we been able to obtain valuable material toward completing the solution of these questions, and our hope for still more and more light upon this important question is in maintaining such a bureau, and that it may be able gradually to extend its influence to more and more new territory whereby it may be able to do better work and obtain more reliable results, and enlighten mankind with the mysteries that preside over the natural phenomena that govern the weather, making them familiar with its workings, whereby they may turn this knowledge to practical account.

STATEMENTS AND COMMENTS.

The first question that seems to present itself in this relation is, "What makes the changes in the weather?" Years ago certain general facts were known about the changes of the weather. Dr. Franklin, it is said, first ascertained that "all storms travel toward the north-east." Though this fact may not be exactly true, it shows that in his time they had some idea of how a storm travels. Then it has also long been known that a storm travels in the "eye of the wind," and that in order to clear away, the wind must come out in a certain quarter; these and many other things were known, yet there was much that could not be known at that age—that must wait for an advanced condition of things to be explained more fully, while such absurd notions that the moon effects the weather by driving away clouds, etc., were also held. This notion about the moon affecting the weather seems to be difficult to eradicate, at least from the minds of the people at large. They claim to know what the weather will be for the month to come by certain signs about the moon, and they believe that the moon has power to drive away or even collect clouds whereby great changes in the weather are brought about. The only possible affect that the moon could have upon the weather would be from its reflected heat from the sun—thereby working in this manner as the sun does, but this heat is so infinitesimal that if it should be concentrated for all night long upon a given locality it would not be able to develop a cloud as big as one's hand.

I. The first source of the weather, as to changes, conditions, etc., is the sun. This, though a common and well-known fact, is simply enumerated with other facts in order that they may here stand, as they act, together.

II. Is the rotation of the earth on its axis.

III. The motion of the earth around the sun.

IV. The parallelism of the earth whereby the light and heat of the sun is made to shine on the earth's surface alternately more on the North pole than on the South pole.

V. These various conditions ever changing their relation to each other have for one of their results what we term the weather.

VI. The text books on natural philosophy tell us that "currents of air, or winds, are produced by the unequal distribution of heat over the earth." The facts gathered by the Signal Service Bureau substantiate the statement; but then very little is gathered from this single statement by which to understand the weather.

VII. When an effect is noticed it is our duty to ascertain the cause. The inquiring mind seeks to get at the most plausible cause. We cannot alter the facts to make them accord with what would seem reasonable to us—we must take them as we find them and build up our theory accordingly.

VIII. Mere meteorological tables taken without relation to one another are of very little account. They form a cumbersome material very awkward to handle. The system now in vogue of daily observations taken, at the same moment of actual time, is far more valuable and reliable as to facilitate the operations of working out the great weather problem.

IX. We should endeavor in this, as in all our labors in behalf of science, to separate whatever is merely accidental or local from that which is general and forms an essential element in the grand laws of the universe.

X. It is the practice of the Signal office to publish three maps a day, but only one, that based upon the observations taken at 7:35 a. m., receives a general circulation. The second and third maps, more specially designated for scientific purposes we presume, are founded upon the observations of afternoon and midnight. More observations the better, for the changes are sometimes so rapid that an observation taken at 7:35 a. m. would give no idea of the actual condition of the weather for the best part of the day.

XI. Some localities are dry and some wet. In some, changes from one condition to the other are rapidly taking place, while in others one condition or the other is more or less protracted. The question is, Why is this so? It would not seem that any one thing was the cause. Nature obeys the strongest force. We see this in all things. The strongest, however, is more or less influenced; it however predominates; yet not without more or less compromise.

XII. The wind from the South, it is obvious, must be warm, while that from the North is cold. As a wind partakes of these elements it will be either warm or cold. Yet at times there are apparent exceptions to this. Sometimes in the winter we have quite a cold southerly wind, but this it will be found to be because what is to us locally a southerly wind is generally an easterly or westerly wind partaking more or less of northern influences.

XIII. All winds from all quarters, that is, all kinds as to force and moisture. The quarter itself not the governing influence only as to cold or heat; for example, more especially in the Atlantic States an easterly wind is dreaded, and thought to bring peculiarly disagreeable stormy weather, yet it does not always, and apparently it is the merest accident when it does. Some of the finest weather we have in this country we have with an east wind, and that, too, without resulting in a storm.

XIV. It is sometimes locally hotter at the North than at the South, because

it is *generally* hotter at the South. This may seem paradoxical, yet it is plainly evident from the facts that bear upon the subject depending on the condition and location of the low barometer center.

XV. In this matter of the weather we need to give our attention to all the laws respecting it, but more particularly to *observe the general rather than the mere local forces*, for the general force will prevail over the local—swallow it up as it were—sweep it along with the tide.

XVI. Change in weather. The great factor that makes the change in the weather is what is termed "low barometer." The great source of which is evidently the variable concentration of the sun's heat upon certain portions of the earth's surface. This fact has long been held, and like many other points in natural phenomena has been controverted and ridiculed, but the later observations by the United States Signal office seem to verify it and place it beyond dispute.

XVII. It is an undisputed fact that there are certain localities where the barometer is much lower than at others;

XVIII. And that the winds from all quarters move toward the centre of *low*.

XIX. Though the winds are in the direction of *low* they do not at all times blow with equal force toward this center. Sometimes it blows the hardest from one direction and sometimes from another, depending upon local conditions.

XX. In opposition to *low barometer* is *high barometer*. So on the weather maps will always be indicated these two extremes.

XXI. There are a great many of these centers of high and low barometer.

XXII. There are large and small centers of high and low barometer.

XXIII. These centers are ever changing.

XXIV. *Low* travels from West to East and generally on a line somewhat North of East, as will be seen by a daily observation of the weather maps. At least this is true as to land. What it is on the ocean we do not as yet know, though there is some evidence that under certain conditions the direction is reversed. We have few facts to prove either that it does or does not, and what little authority there is on the subject would seem to convey the idea that there was no difference in this respect from the land and the sea. Yet if one will follow up the course of *Low* as presented on the weather maps this would not seem unreasonable to believe. We trace a low along the land till it enters the ocean. Then if we will bear (XXV) in mind the fact, that other things being equal (and the *other things* are local forces) the wind will travel in a straight line from *High* toward *Low*. This is both natural and in accordance with the facts of the weather maps, though it has been stated by some that such is not quite the case, rather that the wind is between the two, that is if you stand with your left hand toward *high* and your right hand toward *low* the wind will be directly in your face. The natural forces and the facts of the weather map will not warrant any such a supposed law. The undoubted law is that the wind from all quarters will take the most direct course possible toward the vacuum *low*, and it seems obvious that the wind will take a more direct course on the ocean than on the land, for

here it is all one element—water—consequently there will be less of local forces to detract it. This being the case, even though we know not exactly where *low* is, we can by noting the direction of the wind tell in which direction it is and trace its course.

XXVI. Now in the United States *low* disappears off of the coast, generally, though not always, up in the north-east. By some it is said to be lost in the sea. The wind then begins to blow to the west—north-west—north—then finally around to the north-east. About this time a new *low* sets in down off Florida. In no particular locality, but in this general neighborhood, and at times the movements of *low* are so regular as to present itself in the neighborhood of some one locality on a certain day for weeks, varying in its course but leaving its tracks in part at least over the same ground.

XXVII. This being the case it would seem that low barometer under certain conditions obeyed the other great laws of nature, of the course of our earth around the sun and the planets and comets in general, and that when in *connection with land and water* as on the east coast of the United States (and perhaps on the west coast of continents also) it travels in ellipses; *i. e.* on land generally traveling from west to east and perhaps the same on the sea, but in the immediate vicinity of land and sea from east to west.

XXVIII. Of course we have not the facts to prove this, and it seems contrary to the general fact that *low* travels, at least on land where we can trace it from day to day, toward the east, or the sun, yet the course of the wind along the east coast of the United States, as traced above, would seem to carry with it some weight that *low* somehow or other was differently influenced by the joint action of land and sea to what it was when directly on one element. We know not the facts in the case; we can only infer this—attempt to interpret the unknown by the known. It may be many years before it can be actually proved; yet as an aid toward solving it, it would seem well to have some staunch, swift and able steam vessel to endeavor to prove it by being in readiness up in the north-east when *low* was just moving off the coast, and follow the center of the storm as close as possible. Judgment should not be based on simply one experiment, but it should be followed up a number of times, and even by a number of vessels, that we might have as much information on the subject as it would be possible to obtain.

XXIX. We cannot at present make ourselves familiar with all the changes of low barometer. We have no information from a greater portion of the land surface and can at present have nothing from fixed localities at regular stated intervals from the vast expanse of water, that make up the greater portion of the globe. At some future day, however, we may be able to establish mid-ocean stations,* when we can greatly further our studies of this beautiful system whereby our earth is made habitable. We, however, do already understand enough to see the passing wisdom in having this constant shifting of the areas of low and high barometer, whereby blessing in the form of grateful showers and fruitful sunshine is made continually to visit different portions of the earth's surface—

*A plan for this was suggested by the writer in a paper published April, 1876.

making it more habitable for man—generating the "clouds that drop fatness," and following this up with freshness of air and sufficiency of heat to propagate and maintain life.

XXX. The "first cause" in this department, putting aside heat, etc., is low barometer. Whether we have all the information on this particular point that we can ever ascertain we know not, but one thing we do know, that the lightness of the air at *low* is a fact, and that where *low* is there will be the storm center, and when this passes away and the barometer indicates *high* we will see the sun shine and we shall have what is understood to be pleasant weather again.

XXXI. What makes the conditions we term *low* is not so easy to comprehend. With our present knowledge it would seem more reasonable to us to have low barometer in the vicinity of the warmest places, but (XXXII) a low barometer does not go with a high thermometer, at least so far as we can detect. We have low barometer in regions of perpetual ice. Though at present we cannot comprehend why this should be we can see a passing wisdom in having it such.

XXXIII. The movements of low barometer are much the same in winter as in summer, that is in summer we have northerly winds and in winter southerly winds; though in the winter we have a prevalence of northerly winds and in the summer a prevalance of southerly winds, showing that as the wind is always toward the low barometer that the conditions of low barometer are generally in a higher latitude in the summer than in the winter (*i. e.* north of equator and the reverse south) though these conditions are not confined to localities of latitude.

XXXIV. A theory as to *low*. First, *low* as marked on the weather maps and as generally understood is only relatively low, and so with *high*. A *low* may sometimes be really higher than *high* sometimes is, and the reverse. Then these change as to latitude. Generally throughout the United States 30.30 inches high, and 28.30 very low.

The sun shines on the earth. We may call high or low barometer normal, it matters little so long as we take some definite starting point. In this paper let the whole area of the United States be represented as *high*. In this condition we will have bright sunshine and clear sky. If the earth were one vast plain, and the sun a fixed point of heat, and no water present or near, we should continue to have a sameness of weather for month after month and year after year. But the surface of the United States is not, nor is any portion of the globe generally made up on this basis. There are, however, local spots on the earth's surface answering partially to these conditions but not wholly. The mere condition of the earth's surface in certain localities in flat-plain-like without certain factors to cause, or with certain factors that prevent change, but the sun does not remain stationary, so even though the earth's surface be favorable for a normal condition in itself, the constant changing of the sun's heat and its regular periodical withdrawal would necessarily make changes from time to time. The earth's surface fortunately is irregular and interspersed with much water in addition to the great oceans. The sun must shine over the eastern portion first. The surface of the earth at this point will begin to be heated; this will expand the air immediately

above it causing it to ascend; cooler air will rush in to fill up the vacuum, or perhaps better to prevent it. From the time the sun is relatively to a given spot 45° high in the east to 45° in the west, the greatest heat of the day will be concentrated on that spot. In addition to this the heat of the sun will gradually begin to evaporate the water and form clouds. These obeying the natural law of their peculiar construction will float in the air; showing that they are in this state balloon-like and lighter as a mass than what we call air, even though they have apparently a far more materialistic form. A current of wind is gradually established toward the most heated portion. Clouds are not only being developed here but all over along the path of the sun. The sun will move along on its course, the earth will retain its heat; the water present will have a propensity as it forms in clouds to cool. Perhaps the first day will not make any great change, but after a few days some one point or circuit, say of a hundred miles, becomes established, from the attraction of peculiar local forces and other causes, whereby this air is heated and becomes lighter than its surroundings. Though night comes on and cools the air, the whole of the earth is subject to the influence of night, making the different portions of the earth relative in this respect. So when the sun rises on a new day he as it were takes hold of the near or eastern end of the track where he left off the preceding day. His rays are naturally concentrated where it is the warmest, yet beyond any area of heavy clouds. Of course as there is an effort on the part of the sun to heat there is on the other part of nature a disposition to cool. Clouds are the while developing and even becoming attractive and condensed in themselves, etc.

The process advances till a quantity of clouds or suspended moisture is formed; the more the moisture the heavier the clouds, From all points currents of air set in whereby these clouds are gathered together. This gathering together of clouds and wind produces a number of effects. The winds are from all quarters and therefore of all degrees of temperature, but on the whole the tendency from this is to cool the atmosphere. The presence of the clouds is another tendency to cool even though they become a mantle over the earth for retaining heat. So these facts if nothing more would cause the locality called *low* to be reduced in temperature. The clouds are full of rain and they will precipitate. The sun the while has moved along to another point, where there are less clouds, heating that and going through with the same process say at an interval of five hundred or a thousand miles, more or less, depending on locations causing an attraction of wind and clouds to that spot. The next day the sun rising in the East it will more or less heat spaces to the east of these localities, and perhaps a little north of south, thereby causing, as it were, the centers of *low* to move to the eastward—at least for land. Perhaps, so far as we know at present, the centers of *low* may encircle the earth though there is some evidence (as referred to above) of the sun heating portions more and more to the south of east and gradually working to the south—south-west—west—north and north-east and so around in a circle or circular course—at times larger or smaller. These points as

to the course of *low* at present, however, are not facts; this is only to suggest an account of certain facts seeming to favor it, but whether *low* travels thus or directly across the ocean as on land can only be ascertained by further and careful observation. *Low* is continually on the march generally toward the east, unless there be local exceptions, this much is an admitted fact.

It is said that "a vessel bound to the westward meets *advancing* areas of low pressure, and the observer finds that his barometer falls and rises again more rapidly than it would were he on shore, while an observer on board of a ship bound to the eastward has just the reverse experience."—(Circular Signal office 1878). This if anything would seem to show that water heats and cools more readily than the land and that the sharpest grades of temperature would be on the east of the side the sun approaches the center of *low*. So from the barometer an expert could tell, if he had no other means, the general course of the vessel—eastward or westward. Yet at the same time this does not necessarily prove that *low* does not travel in ellipses. This, however, would seem to suggest that the navigator, especially the officers of the ocean steamers, be requested to note the course of the wind in connection with the low barometer centers; by a careful note of this fact we might be able to determine something quite reliable as to the probable course of low barometer centers.

XXXV. The center of *low* is not the warmest point for various reasons. The generation and concentration of moisture tends to cool, to say nothing of the winds coming in from all quarters north as well as south. This being the case, it has been a subject of warm discussion on the part of some writers on the subject of the weather, Mr. T. M. Butler, for example, (in his "Atmospheric System," 1870) for this and for other reasons contended that the conditions we term *low* could not be thus caused. His idea was not that if *low* was caused by the concentration of the sun's rays on a given point that we could have *low* at places where there is the greatest heat. According to human ideas it certainly would seem that such should be the case, but it is also a law of nature that (XXXVI) the conditions of low barometer is not, at least often, associated with a desert or very dry places, and not at very hot places at the expense of cold places. Other things being equal, *low* will predominate where there is the most water, or at least where there is the most admixture of water, and the reason seems obvious. When there is no moisture, sure, the ground heats up quick, but there is no material for clouds there. The sun is all the while passing on, night comes on, and what was so hot during the day becomes very cool at night. Had there been clouds to center there the heat would have been retained; no heat is retained as a basis for the work of developing a *low* the next day. The process of heating has to be all gone over again. Evidently the best combination for retaining heat is a good interspersing of land and water.

XXXVII. Other things being equal, the *lows* would probably be permanent at the equator, but they are not, and as we become more and more familiar with the facts of the weather the more and more we see the wisdom of the Creator in having the various combinations of heat, the distribution of land and water, the

inclination of the axis of the earth, etc., whereby the weather is equalized, tempered and changed.

XXXVIII. Mr. Butler, after discussing the question of *low* and saying what it was not, put himself on record ("Atmospheric System," page 381) that it was caused by "electricity." Such a man as he we know would not deal with such a thing lightly and say "electricity" in any wiseacre sense. It is not pleasant to controvert one much older in the service than yourself. Perhaps it is electricity, but Mr. Butler did not sufficiently explain his point, and now, for this world at least, he is beyond the power of the discussion of a topic in which he took such an absorbing interest. On this point, however, I would venture the suggestion that electricity itself may, after all, be nothing more or less than heat. Without heat there never could have been electricity; it seems to be only a higher or more subtile form of heat, as it were, bearing about the same relation to heat in general as ozone to oxygen.

XXXIX. Again Mr. Butler maintained that if there was what is now commonly called a "hole in the sky," that clouds must necessarily shoot up through this hole, and he offers quite a reward to any one who ever saw such a sight as a cloud—a scud—going heavenward This he seemed to think conclusive evidence against the theory that *low* is formed in the manner here referred to. The air may go up without taking a cloud. A cloud is only a mass of water combined with air—balloon-like. When a maximum point of moisture is reached the water re-falls to the earth. At a center of *low*, clouds are piling in towards each other; as they are thus brought together they are compressed in proportion to the force of the currents that brought them together and, as it were, the water is squeezed out of them as though they were so many sponges. Where is the air that also helped form them? It is not unreasonable to suppose that it rises towards the heat that is on the upper side of the clouds. So it does not seem inconsistent to believe the common and generally-acknowledged theory on this point—and it would seem very strange to see a heavy rain-cloud take an upward flight—especially when we know that beyond a certain limit the air becomes very rare and incapable of sustaining bodies of any great weight.

XL. It is a fact, however, that the lighter cirrus clouds are often seen moving above the lower and heavier clouds, and in an opposite way from the way the wind is blowing on the surface of the earth. This fact, if it proves anything, would seem to go to prove the "hole in the sky" theory, by showing that there are upper currents, as is also ascertained by balloons moving in another direction from the surface currents. This will readily fit the theory that the air does ascend over the spots called *low* and that the air is seeking to equalize the various forces whereby it exists.

XLI. This is, as it were, Nature's grand plan of ventilation and purification, whereby we have a bountiful supply of fresh air far beyond the demand.

XLII. *Low* travels eastward, at least as a general rule, or towards the sun. Did the sun rise in the west this would undoubtedly be reversed, and we should see storms traveling (generally) from the East towards the West.

XLIII. There is a common saying that a storm travels in the "eye of the wind," i. e., in the direction that the wind is blowing. This is true in some cases, but it must be seen that it cannot approach to the dignity of a universal law—it depends much upon the locality, and particularly upon the relative location of *low*. Along the Atlantic coast this is more true of a North-east storm than any other. There are cases where this for some localities may be true with a North-west wind, when a *low* starts in on the coast and takes a North-west direction. Such a storm center or *low*, however, bends to the East, and apparently goes to prove that *low* travels in circles or ellipses. Familiarity with the motion of *low* and the fact that its *general* course is towards the East, will make it a very easy matter to trace a storm and make us more skillful at forecasting the weather.

XLIV. On the maps the changes are marked *high* and *low*. *High* it would seem, according to the principles here treated upon, should follow *low*, and such appears to be the fact, although it would not seem to rank with *low* as an independent condition, but rather as an adjunct. We could have no *high* without a *low*; the *low* is the governing condition.

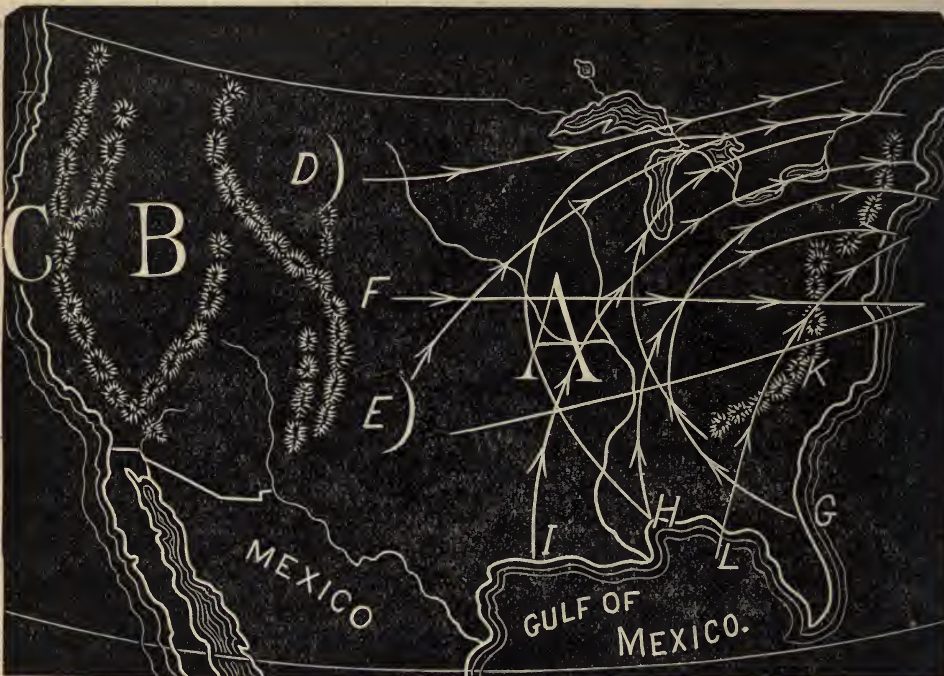
XLV. Can we ever have *low* under our control? It would seem not, yet we evidently can help in establishing centers for *low*, as in deserts, where there are naturally none, by planting trees and inducing foliage to develop, whereby moisture may be drawn up from the earth and what may be present in the atmosphere retained, thereby heat prevented from escaping through the night, etc.

XLVI. Where there is foliage the conditions *low* are more equally and extensively developed, and this leads to (XLVII) the conditions of storms that follow woodless countries. Where the woods are cut away we have great droughts and sudden and fierce winds and rains. As to rain, much depends on the extent of the area of barren soil. In all these changes many influences are at work, and we cannot make ourselves too familiar with the idea that the strongest factor is going to prevail.

XLVIII. When a storm is working up more or less moisture is developed according to the circumstances herein spoken of. If clouds are spread over a large extent of territory and *low* is not very concentrated the precipitation will be light. It is then that rain "comes down like mercy," and does so much good, as it has plenty of time to penetrate the earth, and therein lay up a supply against the seasons of drought. As foliage tends to accomplish this and regulate and equalize it, as it were, it would seem worth our while to heed it. The fact itself is known, yet many facts that we really well know are not fully appreciated until stern necessity presents them to the world in the most forcible manner and in the most powerful light.

XLIX. As has been remarked one *low* follows another at shorter or longer intervals. Again a condition of low may circumvent a place or locality, and then at times one place or locality will have an abundance of rain—rain almost every day for perhaps two weeks, while another will not the while have any; as it were one locality has rain at the expense of another. (See plate).

A *low* may start in on the coast of L and take a regular course toward the



north-east; it may start in at G, take a more or less circular course, and thereby pass locality K, or start in H or I and travel to the northwest, leaving the Atlantic States without rain; or it may, separately or in conjunction with others, start at E, F or D and take a more or less direct easterly course to the Atlantic ocean. These lines illustrate the general course of *low*, but if the engraver should exercise his imagination to the utmost and make the lines so thick and intricate that they could not be deciphered, or lose their identity in multiplicity of directions, he could not give all the changes that are constantly occurring in the paths of *low*. One of the missions of the Signal Bureau will be to note the course of these *lows* and to see how they are associated with any particular season of the year.

L. In nature nothing is more marked than is this matter of rainfall that the strongest factor will prevail. Other things being equal the rainfall will be at *low*, but they are not, so we occasionally have an apparent exception to the fact that low barometer is the cause of rain. On the 10th of April, 1878, *low* was off in the north-west and extended over a large territory. The wind, as was natural, set in to the eastward, and under such conditions it does not move with the rapidity it does when *low* is concentrated, so under these circumstances the clouds were carried along very slowly. They were the while, however, growing heavier and being wafted toward *low*, but coming in contact with a changed condition of atmosphere on the border lines of *high* and *low*, precipitation took place, prematurely as it were, so that there was little or no moisture to precipitate when

the real center of *low* was reached. The strongest factor in this case was the coming in contact with a changed condition of atmosphere. This does not often occur and it would seem could only occur at such times as when such conditions here referred to meet. Yet this would prove, if anything, that clouds were being developed all over—more or less according to circumstances of moisture, heat, etc,, and that the condition *low* was simply a means of concentrating moisture over a given district. Such a condition as this may be difficult to prognosticate. It would be apparently the most natural to expect the rainfall at *low*. This, however, is a fair illustration of one of the many things with which the Signal office has to contend, at least at present; perhaps at some future time when the officers become more familiar with the mysteries of the workings of nature they may know better how to calculate upon the neutralizing influences of what may become under some circumstances, for the time being, the *strongest factor*.

LI. The United States is a fine field to study this subject, and it seems to be divided into three distinct systems; that east of the Rocky Mountains, A; that embracing between the Rocky Monntains and the Pacific coast range on the west, B; the narrow strip embracing between the Pacific ocean and the coast range on the east, C. Could we have the same complete system throughout the world as we have here we could undoubtedly gain still more valuable information as to the working of the weather system. The natural laws are evidently the same though they may not in all parts be in the same balance as here. On the basis of the strongest power prevailing, there may be certain apparent variations which may appear to conflict, when in reality they all follow the same general law.

WASHINGTON, D. C. TO BE CONTINUED.

ON CLIMATIC CHANGES IN THE PRAIRIE REGION OF THE UNITED STATES.

THE EFFECT OF DISBOSCATION ON CLIMATE, AND THE RELATION OF FOREST GROWTH TO ATMOSPHERIC PHENOMENA.

BY COLONEL HENRY INMAN, OF KANSAS.

In the physical structure of the continent two destructive features are presented: one, a vast interior area of thinly wooded prairie, treeless grassy plains and arid deserts; outside of which is found the true forest region—the other distinguishing characteristic. 'No continent of the earth presents these geographical facts to such an extent, in such magnificence, in picturesqueness of landscape, grandeur of forests, length of water-courses, volume of streams, luxuriance of grasses, richness of soil, or susceptibility to a diversified agriculture equal to the immense area included in the limits of the United States. The irregular line which circumscribes the vast interior of the North American continent, is thus correctly drawn by Mr. Lewis H. Morgan in his "Migration of Indian Tribes."—*North American Review* Vol. 108.

The prairies to which this paper is confined, he says: "Stretch from latitude 29°, and south of it to the north of Peace river, in the Hudson Bay Territory, in latitude 60° north. In their greatest lateral expansion they extend from the western part of the State of Indiana in longitude 9°, to the eastern base of the Rocky Mountains in longitude 28°, west of Washington. From this line of their greatest width from east to west, they gradually contract both northward and southward, forming a vast inland plain carpeted with grass, watered by great rivers, and encompassed by forests. The boundaries of this central prairie region will be made familiar by tracing briefly their circuit. Commencing upon the Rio Grande, which forms in part the southern boundary of the United States, and following the general line that separates the forest from the prairie northeasterly, a narrow belt of forest is found in Texas bordering the Gulf of Mexico, but penetrated here and there by the prairie which reaches the gulf at several points, as at the mouth of Nueces river and at Matagorda Bay.

"Louisiana, the eastern part of Arkansas, and the southeastern part of Missouri were originally forests, while all west of this was prairie, with the exception of narrow fringes of forests along the rivers and water-courses, and of small and irregular belts of timber upon the lowlands. Crossing the Mississippi above the mouth of the Ohio, the prairies follow the wide belt of woodland along the northern bank of the Ohio until they reach and penetrate the State of Indiana, where their eastern limit is found, with the exception of prairie openings in central and eastern Indiana, and western Ohio. Turning thence in a northwesterly direction, the prairie touches the foot of Lake Michigan at Chicago, from which point northward the belt of forest along the western shore of Lake Michigan widens so that the dividing line passes a number of miles west of the head of Lake Superior, whence it continues near the chain of small lakes to Lake Winnepeg.

"Keeping to the west of this lake, and of Lake Manitoba, which is also bordered with forest, the boundary line of the prairies runs northwesterly to near the west end of Athapasca Lake, where it crosses Peace river, and extends beyond to Hay river, near the sixteenth parallel, after which it bears southwesterly to the slopes at the foot of the Rocky Mountains. East, north and northwest of this line there is forest, whilst all within is prairie. Upon the plateau of Peace river, in the far north, are found the northern limits of those magnificent fields upon which no eye can rest without wonder and admiration. Southward, along the base of the Rocky Mountain chain, the lower slopes of which are wooded to the edge of the plains, the prairies spread out uninterruptedly to our starting point on the Rio Grande.

"This vast area, which traverses thirty-one parallels of latitude, and nineteen parallels of longitude, in its greatest continuous expanse measures more than seventeen hundred miles from north to south, more than one thousand miles from east to west, and embraces upwards of eight hundred thousand square miles. It is not entirely a treeless region, neither is it separated from the surrounding forests by a sharply defined line."

Only the region beyond the Missouri—confined principally to the states of

Texas, Kansas, Colorado and Nebraska—known as the Great Central Plains—is made the subject of this paper. It would require more space than could be allotted to a magazine article, to treat exhaustively the whole prairie area immediately exterior to the regions enumerated, the results of which, however, would vary but little materially, and only in degree incident to differences in latitude and inherent qualities of soil.

In one of the earlier Agricultural Reports, by the Commissioner of Patents to Congress, the late and deeply lamented Professor Joseph Henry, then Secretary of the Smithsonian Institute, describes the physical geography of the "Great American Plains" as follows: *"From the eastern edge of what we have called the mountain system—that is from the foot of the Rocky Mountain chain to the Mississippi river—a space comprising about one-third of the whole territory of the United States, the surface consists of an extended inclined plain, which slopes eastward to the Mississippi, and southward to the Gulf of Mexico, having at the greatest elevation, near the intersection of the parallel of forty and longitude one hundred and five, a height of upwards of five thousand feet, whence it gradually declines to the Mississippi river to about one thousand feet. At the parallel of thirty-five it has nearly the same elevation, and thence it slopes to the bed of the Mississippi about four hundred and fifty feet, and south to the level of the sea at the Gulf of Mexico.

"This extended plain is traversed by a number of approximately parallel rivers flowing east and southward to the Mississippi and the Gulf of Mexico, which have their rise principally in the mountain system, and are chiefly supplied by the melting of the snow and the precipitation of vapor which takes place at the summit of the ridges. The rivers are sunk deeply below the general surface of the plain, and give no indication of their existence from the distance, except from the appearance of the tops of the cottonwood trees which skirt their borders."

The same authority, in touching upon the general character of the surface and soil of the region under discussion, in its relations to possible productiveness, says: "The portion also on the western side of the Mississippi, as far as the ninety-eighth meridian,* including the states of Texas, Louisiana, Arkansas, Missouri, Iowa and Minnesota, and portions of the territory of Kansas and Nebraska, are fertile, though abounding in prairie and subject occasionally to droughts. But the whole space to the west, between the ninety-eighth meridian and the Rocky Mountains, is a barren waste, over which the eye may roam to the extent of the visible horizon, with scarcely an object to break the monotony."

The distinguished scientist just quoted found, however, before his death, good reasons to change his views in the light of the meteorological records that were completely stultifying previously and hastily formed opinions upon indifferent data, and admitted to the writer some two winters since, the fact of climatic changes in the prairie region of the United States, but was not fully prepared to assign their cause outside of cosmic forces.

That from the ninety-eighth meridian of longitude west from Greenwich, to

* Report of Commissioner of Patents, 1857.

the base of the Rocky Mountains, there exists a "barren waste"—a dry, parched up and uninhabitable region—in fact a desert in the most rigid conception of the term—was firmly believed by the scientific world less than twenty years ago, and is as easily accredited to that region, to-day, by thousands whose knowledge of the geography of the United States, is confined to the description contained in the text-books of their school days, dated a quarter of a century or more in the past.

That the climate of the entire region between the Missouri river and the Rocky Mountains has changed within the last twenty years, and is at present slowly changing, or that the meteorological observations, upon which all the earlier reports of the Great Plains have been based, were incorrect, and do not in the conclusions drawn from them at the time of their compilation accord with the facts as they are known to exist, and that the whole of the vast interior area of the continent west of the ninety-eighth meridian, is not a "barren waste"—is not the "Great American Desert," confidently accepted as true at the date of the report quoted above, and as erroneously believed in by many people, to-day, it is the purpose of this paper to attempt the proof.

While it is true, perhaps, that there are relatively large districts of the Great Plains which must forever remain bound over to a hopeless bondage of sterility, the greater portion that is deemed by thousands in the East as an irreclaimable desert, is surely succumbing to climatic changes, and the remainder, when subjected to an improved system of irrigation, will invite a happy and prosperous population. Another portion again, though precluded by the remorseless rigor of immutable law from a high agricultural development, will remain the great pasturage for the herds of the markets of the world.

The time is not remote, if we may judge from the wonderful phenomena the rapid civilization of the plains presents to-day, when that whole vast expanse of country from the ninety-eighth meridian, to the very foot of the mountains, along their whole length, will offer a picture of the most gigantic and diversified system of agriculture the nations have ever seen. That there is a comparatively rich future for the agriculture of extreme western Texas, Kansas, Colorado, Nebraska, and Wyoming. I think the recorded meteorological phenomena of the immediately preceding ten years and the experience of that pioneer population, whose thrifty little homes dot the wide belt of country beyond the ninety-eighth meridian, will confirm.

The cause, or causes, that have, and are, effecting the ameliorating conditions claimed, are believed by the writer purely local, and apparently, directly or indirectly, attributable to the march of civilization in its ever onward, restless course westward. If these changes in climate are not taking place, and are merely the result of an enthusiasm which the pure air of that section incites, then it must follow as true, that the aqueous precipitation of the Great Central Plains, in its form of rain and melted snow has been—until the last decade at least—differently reported from the facts, in their relations to means and annual totals in inches.

Though true for the limited districts of observation, perhaps, and strictly true for the whole area under consideration in the relations of distribution—which appears to be constant for the entire inter-ocean region—the tabulated results present an array of figures opposed to the agricultural possibilities of that portion of our country, and are directly stultified by the experience of the inhabitants—but from which the "aridity" and "barrenness" have been determined. It is believed that a study of the facts presented in this paper will lead to the conclusion that both of the propositions introduced above, are factors in the problem to be discussed—in other words that climatic changes have, and are taking place, and that the meteorological observations have not been accurately recorded, at least as previously stated, until the last ten years. Not that the latter has been done with a purpose to misrepresent the true meteorological phenomena of that immense interior area, but from causes unavoidable, and from an insufficiency of data to obtain reliable results when considering such an extensive region in its entirety, but too few observations, and too limited districts to correct the errors of non-periodic variation for the scope of country included in the results as tabulated.

A mere glance at the immense disadvantages under which the bureau has labored, to whose charge the meteorological observations of the country have been committed, will dissipate any idea of unjust criticism that may possibly be superficially attributable to the writer in the statement of his propositions.

Until the year 1819 scarcely any record of the meteorological phenomena of the United States was kept. At that date the office of Surgeon-General of the Army was created, and immediately orders were promulgated from that department to the medical officers stationed at the various military posts "to keep a diary of the weather." For seventeen years—until 1836—this "diary of the weather," which was made a part of the specific duties of the medical officers of the army, was limited in its tabulation to the mere temperature of the air and the direction of the wind.

In 1836 rain-gauges were first furnished to the military posts, and the observations of the precipitation in rain and melted snow recorded. In 1843 the system of observations was extended, and at that time the foundation of that magnificent plan for recording the meteorological phenomena of our country was laid, from the results of which, to-day, the medical department of the army may justly gather some of its greenest laurels.

In 1855 a series of hyetal charts was prepared under the direction of the Medical Department of the army, by Mr. Lorin Blodget, based upon the imperfect, or rather incomplete records of observation of the previous years, which unfortunately have been generally accepted as indisputable authority whenever a discussion of the public domain beyond the Missouri touches upon the susceptibility of that region to agricultural development, the argument invariably closing *unfavorably* in its relations to that subject, upon a mere inspection of the curves, and maximum and minimum figures indicative of the aqueous precipitation of the included areas. It was not intended by the constructor of the hyetal charts

under discussion, that they should be received as the final results of a perfected system, but as approximate in their character only and the basis merely of a method which could reach its absolute conclusions alone through a prolonged interval of time. For at the date of the publication of these charts, there were but two or three military posts in all that vast area comprehended in their system, and these were separated by relatively immense distances, the recorded observations at which stations were consequently determined for large districts and covvered only short periods.

By a single glance at any military map for the years prior to the Mexican war, it will be noticed that only Forts Leavenworth and Scott, in Kansas, and one or two posts in the Indian Territory were established before 1849—and these located on the extreme edge, as it were, of the Great Central Plains—so that all the data available in the construction of Mr. Blodget's charts, in their relevancy to that portion of our country which is made the subject of this paper, were confined to the observations at these stations on the mere periphery of the immense interior region of the continent, to a few remote and isolated posts a short distance within that periphery, and the obviously inaccurate and unreliable reports of surveys and exploring expeditions across the Plains, too hurried to be of any value. These charts, therefore, which were intended as approximations only, originally, have been accepted generally as the true exponents of the rainfall and distribution of the third of a continent, in direct opposition to the ideas of their projector and to the now established meteorological phenomena of that region—are accurate only for the eastern portions of the Mississippi Valley, and the contiguous country to the Atlantic coast.

Then the data from which they are constructed, are the results of observations at stations with limited areas, and extending over more than half a century—for this region they reflect great credit upon their author for their scientifie value, but for the scope of country west of the Missouri are of little use, except to show the constancy of some of the phenomena of aqueous precipitation in the United States, in contradistinction to that of Europe, but distinct from the annual fluctuation of the rainfall and its totals of measurement.

As stated by Mr. Blodget, the phenomena of "symmetry and uniformity over large areas, seem to be the great distinguishing characteristic of the meteorology of the United States in its division of the precipitation of moisture. But the constancy of this phenomenon in no sense affects the question, or probable slow change in the quantity of rain or snow, due to rapidly accumulating local influences, which appears to be the fact, or the question of possible variation in distribution—the latter feature, however, is not insisted upon, or is very small if it exists at all—limited in this aspect of the phenomena of the aqueous precipitation to a transcursion of the summer rain-fall into that of autumn.

The rain-fall of the United States presents three peculiarities in its distribution: First—That which falls upon the region east of the prairie limit on the Atlantic slope, varies but little in its measurement between the seasons, or is *equally distributed.* Second—That which falls in the Mississippi Valley is *unequally*

distributed—the rains of spring and summer aggregating nearly three quarters of the annual precipitation. Third—that which falls on the Pacific coast is *periodic*, causing a wet and dry season.

It is to this marked feature of unequal distribution in the immense prairie region of the interior of the United States that we must look for the cause of its treeless condition, and in this connection must devote some space to the origin of the Great Plains and their source of moisture.

In the consideration of the theories that have been advanced by scientists to account for the origin of prairies, in order to arrive at satisfactory conclusions we must recognize three facts which accompany the variability of forest growth. First—In those regions where the rain-fall is large, and is distributed equally between the four seasons, we find dense forests. Second—Where the rain-fall is distributed unequally, the grassy plains are the distinguishing feature. Third—Where the rain-fall approaches zero, we meet the absolute desert. To avoid too great an elaboration of the subject, "The Origin of Prairies," I quote from a concise review of the several theories which have been advanced, as follows:

*"The great controlling influence which has operated to exclude trees from so large a portion of our territory west of the Mississippi, is unquestionably a deficiency of precipitated moisture. To this cause are due the prairies of Oregon, California, New Mexico, Utah, Nebraska, Kansas, Arkansas, and Texas. Throughout this great area, we find every variety of surface, and soil of every physical structure or chemical composition—unless in exceptional circumstances, where it receives an unusual supply of moisture—if not utterly sterile, covered with a coating of grass. * * * * * To the Great Plains, the typical prairies of the Far West, the theories proposed for the the origin of prairies, viz., that of Professor Whitney, that they are due to the fineness of the soil; or that of Mr. Lesquereux that they are beds of ancient lakes; that of Mr. Desor that they are the lower and level reaches of sea-bottom; or finally that which attributes them to annual fires; are alike wholly inapplicable. * * * * The prairies bordering on, or east of the Mississippi, may be, and doubtless are, partly or locally, due to one or more of the conditions suggested in the above theories; but even here the great controlling influence has been the supply of water. The structure of the soil of the prairies coinciding with the extremes of and supply of rain characteristic of the climate, have made them now too dry and now too wet for the healthy growth of trees. A sandy or rocky soil or subsoil, more thoroughly saturated with moisture and more deeply penetrated with the roots of forest trees, affords them constant supply of the fluid which to them is vital. This, as it seems to the writer, is the reason why the knolls and ridges, composed of coarser materials, are covered with trees; while the lower levels, with firmer soil are prairies. Where great variation of level exists, the highlands are frequently covered with trees, in virtue of the greater precipitation of moisture which they enjoy."

From the date of the earliest explorations of the interior of the continent,

* On the flowering Plants and Ferns of Ohio, Dr. J. S. Newberry, 1860.

until quite recently, the cause of the treelessness of our Western prairies has been attributed solely to the annual fires which sweep over that region; and it is a favorite theory with many people, to day, who have studied the subject only superficially, but scientists have generally relegated the problem to the domain of meteorology, where is found its true solution.

Professor Dana, the eminent geologist, hints at the pertinency of Dr. Newberry's conclusions on the subject thus: *That prairies, forests and deserts are located by the winds and temperature, in connection with the configuration of the land. * * * * It is unquestionably true, however, that the annual fires have been an important factor in preventing the encroachment of the timber which fringes the rivers, upon the contiguous prairie, but only for inconsiderable distances, in other words; its action has been confined to a rigid line, whose course follows the contour of the stream where its supply of moisture to the soil of its banks ceases.

In his argument to prove that the prairies are not due to peat-growth or to the texture of the soil, Professor J. W. Foster (the very best authority on physical geography) says: †"It is a microscopic view to undertake to trace analogies between the formation of the prairies and that of the treeless morasses known as peat-swamps, as has been done by Lesquereux, a distinguished botanist, in the first volume of the "Illinois Geological Reports." It is a theory which presupposes a humid climate, a level country with imperfect drainage, and with a surface dotted over with lakes and sheltered from the winds, where the peat-producing plants could grow—conditions none of which obtain where the prairies assume their grandest proportions.

[Take for example, Kansas: So great is the relief and depression of the soil, that standing on one of the "rolls," I have commanded a view of forty miles in extent. The rise of the Kansas slope is two thousand two hundred feet in the distance of four hundred miles.

"Dr. Logan (Report on the Geology of Kansas, 1866) remarks: There is but little marshy or spongy soil in the whole State; the surplus water coursing down the natural conduits, leaves no opportunity for the saturation of the ground, which is observable in some of the other states, and particularly the prairie states east of the Mississippi river. * * * * Hence, no ponds or sloughs are formed, and but rarely any spongy soil."]

"We can hardly conceive of conditions by which the whole surface of a country would be converted into a peat bog. Such bogs are generally found occupying erosions in the surface, and where they are sheltered from the winds. There is no tendency to the formation of peat along the shores of the Great Lakes, where the waters are agitated by storms, nor along the margins of rivers of briskly-running water. Peat vegetation then only thrives in still waters, and where there is a tendency to stagnation; and the area over which it extends in a given region is inconsiderable, compared with the area occupied by other vegetable forms. The aromatic sage-plants, the cacti, and the bunch-grasses, are

*Manual of Geology, 1863. †"The Mississippi Valley," Chicago and London, 1869.

forms of vegetation which characterize the Western Plains, and are unknown in a region favorable to the growth of peat.

The Llanos of Venezuela have many features in common with the prairies; but they are subject, each year, to droughts so long continued and intense that the soil cracks and bakes, and the carbonized particles of vegetation are whirled through the air in the form of fine dust. Such climatic conditions would preclude the growth of peat vegetation. It is evident therefore, that we must resort to other and different causes to explain the phenomena of these grassy plains.

"Other physicists would attribute the formation of prairies to the mechanical or chemical condition of the soil,—a theory which we think equally untenable, when we reflect that the surface of these treeless plains may vary in every degree between drifting sands and impervious clays, and that the efflorescence of soda and gypsum which are the evidences of an arid climate at one extremity of the continent, would become fertilizing agents at the other. The forest of Fontainbleau thrives on a plain composed of sand to the extent of ninety-eight per cent. of the whole contents; the region of the Colorado Valley, the most desolate portion of the United States, is often underlaid by a blue clay so indurated as hardly to be impressed by a mule's hoof in passing over it; the soil of the Llano Estacado is red clay and gypsum, which under certain conditions of moisture, would be highly productive; and even the entire region of Sahara is far from being a mass of drifting sands."

It will be conceded that the question of the "Origin of Prairies," so far at least as their destitution of trees is concerned, is a purely meteorological one, and upon which can most satisfactorily be predicated the mutations that are rendering them adaptable to the support of a vast civilization, the nuclei of which only a few years since stepped hesitatingly within their enigmatical and mysterious confines.

The discussion of the cause of the treelessness of our Western prairies is a most important one when we enter upon the possibilities of their future in this connection; and in order to support the belief that man in his wonderful power to subordinate nature to his demands, can clothe the grassy plains with arborescent farms, and within certain limits change the climatic conditions favorably to this consummation, it is necessary to enter into all the details of the subject of moisture in its connection with its source in the region of the interior of the continent,—to compare the meteorological phenomena of to-day, with those which existed primarily, or before civilization had commenced its encroachments, and then determine whether the modifications assumed are facts, or purely visionary, or merely the recurrence of long cycles of variability.

The source of the rains which fertilize the United States, is found in the winds, that, laden with aqueous vapor taken up from the ocean and Gulf of Mexico, pass over respective regions and deposit their burden in the form of refreshing drops. It is only, however, the source of moisture of the Great Central Plains that we have space to discuss, though the whole subject in its relation to the entire continent is an intensely interesting one.

*"The southwest winds of the United States are found to prevail with wonderful regularity on the Atlantic, north of the calms of Cancer; but in the region of the Caribbean Sea and the Gulf of Mexico, there are abnormal conditions which present a marked deviation from the fixedness and uniformity observable in the winds of the mid-Atlantic and the North of Africa. Both southerly and northerly winds blow with violence across the parallel of thirty (in the belt of the calms of Cancer) which, away from the American continent, acts as a great wall between the southwest and northeast winds. In the summer season, the northeast trades, hot and moist from the equatorial zone, as they enter the Caribbean Sea, are deflected by the lofty chain of the Andes which girds the coast, and pass into the Gulf of Mexico, where they become inland breezes on the coast of Texas; and as they penetrate the interior they are gradually deflected east, until they reach about latitude thirty-nine, when they assume the direction of the great southwest aerial current. It is this deviation from the regular flow, which gives to the Mississippi Valley its moist, tropical summer climate."

By a careful study of the statement quoted above—no longer disputed I believe, by meteorologists—we have a convincing cause for the unequal distribution of rain on the Great Central Plains. It is to the northeast tradewinds of summer then, as they are deflected and pass over the Gulf of Mexico, thence into the prairie region of the interior, that we are indebted for the excess of precipitated moisture in the first two seasons of the year, and why the plains are as well supplied with rain in summer as the Atlantic coast. If this were not the cause of the phenomena of the moisture of that region, and it depended for its supply upon the great southwest aerial current, in the zone of which the United States is situated, it would be of little use to discuss any agricultural possibility for the future of the interior of the continent, and climatic changes in its aspect of the rain-fall would be impossible.

Professor Foster, on the theory of the southwest winds being the medium of the moisture which falls upon the United States says: †"More than one writer on the climatology of the United States has maintained that the moisture which bathes the continent is mainly derived from the Pacific ocean, and distributed by the great southwestern current of winds, without taking into consideration how far that current is modified by the configuration of the continent. If this theory of the southwest origin of the moisture be true, we should justly infer that the winds of the Pacific, however highly charged, and apart from a great mountain barrier, in passing over seventeen degrees of longitude, would become dry winds long before reaching the Atlantic slope, and the conditions of the fertility of the continent would be reversed. The Alleghanies would be as desolate as the Purple Hills, and the Colorado Desert would be as fertile as the Valley of the Shenandoah."

We cannot, in attempting to establish the fact of climatic changes in the region of the Great Central Plains, restrict our inquiries to the single subject of the rain-fall, but are compelled to deal more or less with other meteorological phenomena,

*Professor J. W. Foster's "Mississippi Valley." †"Mississippi Valley," 1869.

in order that the intelligent reader may have the fullest data to reach his conclusions. It is necessary, then, in the determination of the postulate which is the basis of this paper, to institute a comparison between the various phases of the meteorological phenomena of the interior prairie area under discussion, as presented primarily—in this sense to the earlier observer—and the same divisions of the meteorological phenomena as they appear to-day.

Many of the conclusions that have been arrived at in relation to the Great Plains, are based upon the early literature descriptive of the prairies, and while much that is narrated therein is true, perhaps, more is false, and the prejudices engendered by the exaggerations which were accepted as facts, still cling to the popular belief, and, strange as it may seem, are yet incorporated in works that aspire, at least, to the scientific.

To show the general characteristics of the prairies beyond the Missouri, as they evidently were thought to be, and to portray features of that region which existed within the recollection of the writer, but which no longer exist or are modified, I quote from two authors on the subject:

"*Vast grassy plains, with trees restricted to the immediate banks of the streams—this is the character of the country between the Missouri river and the base of the Rocky Mountains, but as the traveler advances from east to west, he begins to notice increasing signs of dryness in the atmosphere, and of a more marked continental climate. The rain-fall becomes insufficient for the cultivation of crops, and the diurnal changes of temperature are too abrupt to permit the growing and maturing of the sub-tropical plants cultivated for food. The thermometer may rise to seventy or eighty degrees at mid day, and drop to below the freezing point at night. Not a cloud for days dims the luster of the sun, and at night are shed no refreshing dews. The purity of the air is so great that wild meats are cured without the aid of salt, and the grasses dry up without a loss of their nutritive properties. Surrounded by a medium so dry, elastic and bracing, the *voyageur* toils under a heat of ninety degrees without exciting excessive perspiration, and at the same time his system is proof against the chilling air of the night. Those stifling and enervating heats, and those cold and disagreeable storms, characteristic of the humid regions to the east, are here unknown, and the atmosphere itself becomes highly electrical. * * * * * * The buffalo or "gramma" grass, of which there are several species, is another marked type of the Plains. It grows in tufts, having a narrow, slender leaf, and where it exists in all its perfectness, the surface of the soil resembles a sheep lawn. It dies down under the heats of summer, and the climate is so dry that its nutritive properties are preserved, and thus, at all seasons of the year, it affords sustenance to the immense herds of buffalo which roam over the Plains."

The other author says: "†As we recede from the influence of the Gulf winds, and come in contact with the true climate of the prairies, it becomes constantly dryer, since the remaining region is now shut in upon the west by the double barrier of the Rocky Mountains and the Sierra Nevadas, which deprive

*Foster's Mississippi Valley, (1869.)
†Lewis H. Morgan, Migration of Indian Tribes, North American Review, Vols. 108–9.

the winds of their moisture in their passage from the Pacific eastward. After traversing about one hundred and fifty miles of Kansas, to the twenty-second meridian west of Washington*, the western limit of arable land in the prairie area under consideration is reached. Westward of this line the dryness of the climate continues to increase, the trees diminish in number and decrease in size, and finally disappear from the margins of the rivers. The grasses, yielding to the same influence, become less and less luxuriant, until the prairies, long before they reach the base of the mountains, degenerate, under the summer sun, into arid plains. Northward, on the Upper Missouri, the grasses never attain the luxuriance which they display in Eastern Kansas and Nebraska, by reason of the trend of this river, but on the upper Mississippi, and along the Red River of the North to Lake Winnipeg, they maintain a vigorous growth. The most perfect display of the prairie is found in the eastern parts of Kansas and Nebraska.

"It is no exaggeration to pronounce the region, as left by the hand of nature, the most beautiful country in its landscape upon the face of the earth. Here the forest is restricted to narrow fringes along the rivers and streams, the courses of which are thus defined as far as the eye can reach, whilst all between is a broad expanse of meadow-lands, carpeted with the richest verdure, and wears the appearance of artistically graded lawns. They are familiarly called the rolling prairies, because the land rises and falls in gentle swells, which attain an elevation of thirty feet, more or less, and descend again to the original level within the distance of one or more miles. The crest lines of these motionless waves of land intersect each other at every conceivable angle, the effect of which is to bring into view the most extended landscape, and to show the dark green foliage of the forest trees skirting the streams, in pleasing contrast with the light green of the prairie grasses. In their spring covering of vegetation, these prairies wear the semblance of an old and once highly cultivated country, from the soil of which every inequality of surface, every stone and every bush has been carefully removed, and the surface rolled down into absolute uniformity. The marvel is suggested how nature could have kept these verdant fields in such luxuriance, after man had apparently abandoned them to waste. This striking display is limited to about one hundred and thirty miles in the eastern part of Kansas, and a narrow belt in Eastern Nebraska."

Both of the above descriptions were written a decade ago, and in part, at least, were drawn evidently from the earlier and stereotyped idea of the Plains, and in part, perhaps, from limited personal observation of the mere portals, as it were, of the grand prairies of the Far West. Much of this is a faithful representation of the phenomena then existing, but which no longer exists, and many of the features so eloquently pictured are confined to limits ridiculously contracted in comparison to the whole area. What are the facts to-day? Where the rainfall was declared "insufficient for the cultivation of crops," magnificent farms have been opened, and results obtained which have definitely determined the question of the productiveness of the region; where no "refreshing dews" were shed, we

*West of Greenwich.

find dews as copious as in the most favored localities; and where ten years ago "wild meats" could be cured "without the aid of salt," putrefaction takes place as rapidly as in the most humid climate of the east. Now the temperature is more equable, the nights less chilly and the heat of the noonday sun less "stifling." Instead of the limit of arable land reaching only "one hundred and thirty miles," the country has a constantly and rapidly increasing population, and is successfully cultivated nearly *two hundred miles beyond* the line drawn by the last quoted authority, and each month the plow is turning up the sod, on its eager way to the horizon. The "golden belt," or great wheat zone, has not yet reached its limit, and where was considered a desert by the distinguished authors referred to above, may be seen the grandest yield of cereals on the continent. Where "the trees disappear entirely," young forests have sprung up, and the apple and the pear are making the prairie air redolent with the perfume of their sweet blossoms. But of this farther on, when we come to deal with the actual statistics. The buffalo or "gramma grass," referred to above by Prof. Foster, which once covered the whole region as far east as Fort Riley, is rapidly disappearing—(strange as it may seem, with the departure of the buffalo this grass appears to vanish, too)—and its place usurped by the succulent "blue-stem." Besides this, over extensive areas new forms have appeared, prominent among which is a species of wild barley, (*hordeum pretense.*) The timber that was "confined to the streams" is encroaching upon the contiguous prairie to an astonishing degree, where permitted by those who own the land where the phenomenon occurs. The cultivation of the bottom lands has made this encroachment possible, but it is not confined to the immediate low lands of the rivers and creeks. Fields that have been plowed in the summer or fall, comparatively remote from the water courses, are found in the following spring to be covered with shoots of the cottonwood, elm, box elder and other indigenous trees, from the seed wafted there by the wind. This phenomena can be witnessed to-day, three hundred miles or more beyond the Missouri river; these gratuitous growths attaining a height of from four to twelve feet according to species, in only two or three seasons.

In presenting some of these prominent facts, which will be extended farther on, what bearing they have upon or how far they answer the question asked by meteorologists half a century ago: "Whether in a series of years there be any material change in the climate of a given district of country, and if so, how much does it depend upon cultivation of the soil, density of population, etc.," the reader may judge; but his conclusions from the facts offered for his investigation it is believed will establish the affirmative of each division of the interrogatory, for the meteorological phenomena of the Great Plains when that region was in its primitive condition, compared with that which distinguishes it to-day, appear to confirm it conclusively.

The Great Plains of the interior of the continent are the field in which this question can be definitely determined, for that region during the last ten years has been under the test of rigid observation and experience. Three thousand

square miles of its surface has been completely metamorphosed by the encroachments of civilization, and not by a slow and erratic march, either, but by a steady, constant rapid flow, whose influx has converted extensive areas of the virgin prairies into thrifty farms in a single season, the immigrants not having to contend with the tedious process of subduing the forest, as did their ancestors of the densely-wooded Atlantic coast.

The opinions on possible changes in climate, in this particular of the influence of civilization over certain regions, have been usually based upon the meteorological conditions of Europe as presented to-day, and comparing them with what it seems to have been thousands of years ago; a method of research which is obviously based upon the grossest inaccuracies, the reliable observations too few, the periods of time too remote, and the changes so slow, that their ratio to alleged causes can scarcely be considered within the domain of probability.

The fact is that the southwest winds, laden with vapor from the Pacific ocean, part with the last drop of their moisture as they leave the lofty summits of the Sierra Nevada, and from there continue their course absolutely devoid of aqueous vapor, so that if the prairies of the region west of the Missouri depended upon these winds for their fertility, they would be only inhospitable deserts. The theory that the southwest winds of the Pacific are media of moisture for the central area of the continent, was a natural one, superficially viewed, and was materially assisted by the fact that the rains come with that direction of the wind. Without eliminating the other fact that the actual rain-bearing wind had really only joined the constant current from the southwest by deflection, it was natural to fall into the error.

Upon the question of distribution, considerable is still to be discussed, and before entering upon other branches of the meteorological phenomena of the Great Plains, some space must be devoted to it, that we may arrive at an intelligible summing up; for on the variability of the precipitation of rain over the four seasons, depends the possibilities of a fully developed system of agriculture in any region. Observation has proved that where the annual precipitation reaches nineteen or twenty inches, but is principally confined to the spring and summer months, the grasses revel in their greatest luxuriance to the exclusion of trees. But if the same amount be equally distributed, that region would justly fall under the odium of "barren waste." In consequence of this unequal distribution on the Western plains, where as previously observed, three-quarters of the rain-fall occurs in the spring and summer months, the "golden belt," as it is termed, or wheat producing zone, is pushed yearly farther toward the mountains, keeping pace with the advance of civilization.

Any change, then, in the distribution, with a tendency to equalization over the four seasons without an increased measure of inches, would prove disastrous to all hopes of a successful agriculture, and relegate those fields of golden cereals beyond the ninety-eighth meridian, to an arid desert. But this feature in the meteorological phenomena of the plains is apparently constant, and the changes that the march of civilization have made, are not disturbing its immutability with

other mutations in climate, and with an increased annual precipitation, this distinctive characteristic is preserved.

It has been shown that the treeless aspect of the prairie region is purely due to its meteorological conditions, that the rain-fall has not been sufficient to sustain forests on its soil *primitively*, on account of its limited fall in inches and unequal distribution; but how much less would it have sufficed, if it had been equally distributed? There are two systems of precipitation, therefore, in the economy of the rain-fall in the United States, which it is well in connection with our whole subject to examine. Professor Foster has condensed from the hyetal charts referred to, a representation of this phenomena, from which I quote, ignoring, however, the measurements in inches for certain areas which I am satisfied are incorrect—being mere approximations—but when used as a simple exponent of the "symmetry and uniformity of the rain-fall over large areas," fully explain this feature of the meteorology of the American continent:

*" *Winter*—The mouths of the Mississippi and the region of Pensacola are in the area of greatest precipitation. From this center, the lines of equal precipitation on the west, maintaining a considerable parallelism, first bear northwest along the Texas coast; then rapidly curving, bear northeast; then east, and, as they leave the continent, northeast.

Autumn—The mouths of the Mississippi and the region of Pensacola are within the area of greatest precipitation. The lines of equal precipitation pursue a north northeast direction.

Summer—The lines of summer precipitation, owing to the operation of the law of unequal distribution, are very irregular. On the plains they bear nearly north and south; but, as protracted east, they make one curvature to the south, as they approach Lake Michigan, and another still more abrupt, as they approach the Alleghanies; equal to five degrees of latitude—after passing which, they curve abruptly to the northeast.

Spring—The lines of equal precipitation exhibit a remarkable deflection to the northwest. * * * * While the mouths of the Mississippi and the region of Pensacola still receive the greatest amount of precipitation, Fort Laramie on the plains is nearly as well watered as New York on the seaboard; and Chicago receives no more rain than falls in Cheyenne, at the base of the Rocky Mountains."

In the above reference I have eliminated all the measurements in inches, and the tabulated results which accompany the conditions of each season as given, because they are to me manifestly incorrect; which statement is based upon my own personal knowledge and extended research and calculation in the meteorological records of the station.

A careful study of the phenomena of aqueous precipitation shows it to be one of the most erratic and fluctuating in its value of measurements; one year reaching an insignificant minimum, and the next year perhaps shooting far beyond the bounds of any accurate maximum for long periods, so that a diagram

*Foster's "Mississippi Valley," 1869.

of the annual fall for a series of years exhibits a curious instability of line, and it is only by taking the mean of a number of years, and comparing it with the mean of former similar periods that we can best show the increase or decrease over particular areas. A diagram showing at once the aqueous precipitation of the world would exhibit the same inconstancy of lines, for the blessing of rain is by no means equally distributed over the earth. In the British islands the average is one hundred and fifty-six rainy days in the year. Then there is the broad rainy belt of the tropics, one thousand miles wide, within which the rain pours periodically with torrent violence; and on the other hand there are the great rainless districts of Africa, Arabia and South America, including many millions of square miles on which the music of the rain-drops is seldom heard. At Muhableshwwr, in India, three hundred and two inches of rain have fallen in a single year, enough to cover the land with water twenty-five feet deep. On the Western Plains and in the mountains we have "cloud bursts;" where the rain comes down in limited areas in a perfect deluge, carrying everything before it in its power. *(To be Continued.)*

SCIENTIFIC MISCELLANY.

FLYING MACHINES IN ALL AGES.

Grecian fable points to the Athenian monarch Dædalus, contemporary of Theseus and Minoes, as the inventor of the first flying machine. Celebrated in poetic fiction as an artist and mechanician, the mythical story of his having crossed the Ægean by means of wings of his own construction is but one of many tributes to his inventive genius. Later on, the classics allude to many heroes who were successful in navigating the air; but the acçounts when carefully examined usually resolve themselves into exaggerated stories of feats performed on ropes, wings having been probably employed for the purpose of making the exhibition more attractive, or perhaps to render the performance less difficult by the resistance to the air. Other instances are on record of persons who, by contrivances resembling the modern parachute, descended obliquely to the ground from the summits of high towers. Some time during the thirteenth or fourteenth century a monk named Elmerus is said to have flown more than a furlong from the top of a tower in Spain. This distance is, however, probably much exaggerated. In the seventeenth century Besnier, a lock-smith at Stable, in France, who prudently began from windows one story high, finally ventured to leap from very elevated positions, and so passed successfully over houses and also rivers of considerable width. All these were feats destitute of utility, though they encouraged the expectation of better results which was cherished by some of the most scientific men of that period. Bishop Wilkins (1648), in particular, devoted much attention to the subject. Perceiving the inadequacy of the human arm and

the muscles which move it to give sufficiently rapid motion to wings of sufficient size, he suggests that "it were therefore worth the inquiry to consider whether this might not be more probably effected by the labor of the feet, which are naturally more strong and indefatigable." So confident was the good bishop of success, that he anticipated a time when man should as readily call for his wings to make a journey as he did then for his boots and horse.

The first really important step toward what is learnedly called aerostation was made by the discovery of the balloon. This resulted from the experiments of two brothers, Stephen and Joseph Montgolfier, sons of a paper maker at Annonay, a French town about forty miles from Lyons. The young men had observed the suspension of clouds in the atmosphere, and it occurred to them that if they could inclose any vapor of the nature of a cloud in a large and very light bag, it might rise and carry the bag with it in the air. They accordingly made experiments, inflaming bags with smoke from a fire underneath, and found either that the smoke or some vapor emitted from the fire did ascend and carry the bag with it. Being thus assured of the correctness of their views, they determined to have a public ascent of a balloon on a large scale. They accordingly invited the States of Vivarais, then assembled at Annonay, to witness their aerostatic experiment; and on June 5, 1783, in the presence of a considerable concourse of spectators, a linen globe of one hundred and five feet in circumference was inflated over a fire fed with small bundles of chopped straw. When released it rose rapidly to a great height, and descended at the expiration of ten minutes at a distance of one and one-half miles. The news of this remarkable experiment spread to Paris, and a subscription was started for the purpose of raising money to repeat the experiment. This time the balloon was made of silk, varnished with a solution of gum, and through the suggestion of M. Charles, a professor of natural philosophy, hydrogen gas was substituted for the vapor emitted by the burning straw. During the process of filling the balloon, which took place at the Place de Victoire, the excitement became intense, and bulletins were issued daily noting the progress of the inflation. Finally the crowd throughout the neighborhood became so great that it was deemed wise to change the location. Accordingly the balloon was removed to the Champs de Mars—a distance of two miles. This was done secretly in the middle of the night, and the appearance of the balloon on its travels, preceded by lighted torches and escorted by a detachment of soldiers, is described by those who witnessed it as very remarkable. On the day of the ascent, which took place on the 27th of August, 1783, an immense concourse of people covered the Champs de Mars, and every point in the vicinity from which a view could be obtained was crowded. At five in the afternoon a cannon was discharged as a signal, after which the balloon was immediately let loose. It rose with great rapidity to a height of some 3,000 feet, more than satisfying the expectations of those connected with the enterprise. A shower of rain, which began to fall directly after it left the earth, in no way checked its progress, and the excitement was so great that thousands of well-dressed spectators, many of them ladies, stood exposed, watching the balloon intently the whole time it was in sight, and were thoroughly drenched. After

remaining in the air some three-quarters of an hour, the balloon fell in a field near Gonesse, about fifteen miles distant, and terrified the peasantry so that they tore it into shreds.

After this, frequent experiments of the same character were made, but the first human being to mount in a balloon was a young Frenchman named Francois Pilâtre de Rosier. On the 15th of October, 1783, and on several subsequent occasions, he made successful voyages through the air; but his enthusiasm in ballooning finally resulted in his death. The honor of having made the first ascension in England has been ascribed to two persons—a literary man named Tyler and a foreigner called Lunardi. Although the former justly claims precedence by a few days, his attempts and partial success attracted little attention, while Lunardi's experiments excited the greatest enthusiasm, and were finally the means of introducing aerostation to the notice of English scientists. Lunardi's original balloon was thirty-three feet in circumference, and was exposed to public view at the Lyceum, in the Strand, where it was visited by upward of 20,000 people. After some difficulties in regard to arrangements, it was decided that the balloon should ascend from the Artillery Grounds, and on September 15 the inflation with hydrogen gas took place. It was intended that Mr. Bigin, an Englishman, should accompany Lunardi; but the crowd became impatient, and the latter deemed it prudent to ascend alone, with the balloon only partly filled, rather than risk longer delay. Unable to enjoy human companionship, he took with him a pigeon, a dog, and a cat, and made the ascent in the presence of the Prince of Wales and an enormous crowd of spectators. Shortly after starting the pigeon escaped, and within an hour and a half he descended in Hertfordshire and landed the cat, which had suffered from cold. He then ascended again, and descended after a lapse of three-quarters of an hour at Standon, near Ware, where he had great difficulty in inducing the peasants to come to his assistance. Finally a young woman seized one of the cords, and called the men to follow her, which they did.

The excitement caused by this ascent was immense, and Lunardi at once became the star of the hour. He was presented to the king, and was courted and flattered on all sides. To show the enthusiasm displayed by the people during his ascent, he tells in one of his own letters how a lady, mistaking an oar which he dropped for himself, was so affected by his supposed destruction that she died in a few days; but, on the other hand, he says he was told by the judges that he had certainly saved the life of a young man, who might possibly be reformed, and be to the public a compensation for the death of the lady, for the jury were deliberating on the death of a criminal whom they must ultimately have condemned, when the balloon appeared, and every one became inattentive, and to save time they gave a verdict of acquittal, and the whole court came out to see the balloon. The king, also, was in conference with his ministers, but, on hearing that the balloon was passing, he broke up the discussion, remarking that they might resume their deliberations, but that perhaps they might not see Lunardi again; upon which he, Mr. Pitt, and the other ministers viewed the balloon

through telescopes. From this time balloon ascensions frequently took place in England, the populace taking immense interest in such exhibitions. The result was the expenditure of large amounts of money and the loss of a few lives; but the balloon still remained a toy, resisting all efforts on the part of scientists to make it of practical value. During the wars of the present century balloons have frequently been been sent up for the purpose of observing the movements of the enemy, and ascents have also been made for scientific purposes, such as ascertaining the drift of aerial currents and the condition of the atmosphere at various heights. In the first case they were in some measure successful, but the contributions made to science through experimenting with balloons have been exceedingly small.

In the United States aerostation has been prosecuted with great zeal, and the adventures of Mr. Wise and other famous aeronauts have frequently served to amuse the public. Flying machines have also appeared from time to time, illustrating the force of Yankee ingenuity, but failing to command respect by their want of success. Recently, however, a new impulse has been given to the project of navigating the air by the invention of a flying machine in which the lifting power of the balloon is supplemented by a curious device which enables the operator to control his machine by the action of his feet

The lifting power is afforded by a horizontally placed cylinder of "gossamer cloth" (fine linen coated with India rubber) twenty-five feet in length and thirteen in diameter, weighing only sixty-six pounds, and charged with hydrogen gas, which is made by the usual process from iron turnings and sulphuric acid. Broad worsted bands extend over that and down to a rod of mandrel-drawn brass tubing, nickel-plated, one and one-half inches in diameter and twenty-three feet long. From that rod the machine is suspended by slender cords. The after-portion of the machine is at the base a parallelogram of rods two feet wide and five and one-half feet long, from which rise lengthwise curved rods eighteen inches high in the centre, and drawn near together at the top. All these rods are in reality hollow tubes of mandrel-drawn brass, light and very strong. Above the apex of this form rises a cog-edged steel wheel eleven inches in diameter, with double handles so geared to a four-bladed fan moving horizontally directly beneath that the operator can give the fan 2,000 revolutions per minute. The four blades of the fan are of white holly, each having a superficial area of about fifty square inches, and the extreme diameter of this revolving fan is twenty-four inches. The blades are set at a slight angle, like those of the screw of a propeller. Just behind the wheel is a very small seat, upon which the operator perches. His feet rest upon two light treadles above and in front of the fan. From the front of this form spring other rods, carrying at their extremity a vertically working revolving fan like that beneath the operator's seat, except that it is but twenty-two inches in diameter. It is so geared to the main or horizontal fan that it may be operated or not, at the pleasure of the driver of the machine, and can be made to turn from one side to the other so as to deflect the course of the machine in the air. This fan will make two thousand eight hundred revolu-

tions per minute when the other is making two thousand. All its movements are controlled by the operator's feet. When he presses the left treadle he throws it into gear, when he presses with the toe of his right foot it turns to the left, and a slight pressure of his heel whirls it over to the right. He can also reverse the action of his main fan, so that when it whirls one way he goes down, and when its course is reversed he mounts in the air.

The great problem which inventors of flying machines have always before them is the arrangement of a device by which they shall be able to propel their frail vessels in the face of an adverse current. Until this end shall have been achieved there will be little practical value to any invention of the kind. In Professor Ritchell's machine, however, the difficulty has been in a great measure overcome. On the occasion of the trial trip, which took place on Wednesday, June 12, at Hartford, Connecticut, the new air ship rose to a height of two hundred feet, and sailed off until over the Connecticut river, the operator meanwhile exhibiting his power to change its altitude and direction at will. When he ascended there was but little wind blowing, and the machine appeared to be under perfect control; but gradually a breeze sprang up, and it was deemed safest to make a speedy return, as there were indications in the sky of a gathering storm. The machine turned and made its way back in the teeth of the wind until directly over the ball ground whence it had ascended, and then alighted within a few feet of the point from which it had started.

It yet remains to be seen whether the new machine can be perfected so as to make it available for any useful purpose. At present, however, it is a great success to the inventor, vindicating so thoroughly as it does the correctness of the principles upon which its construction was based.—*Harper's Weekly.*

IMPROVEMENTS IN MUSICAL INSTRUMENTS.

Two very remarkable improvements in musical instruments are occupying the attention of mechanics and musicians at the present time, which are of more than usual interest; the one bears upon the prolongation of a pianoforte note at the will of the performer. Hitherto the note could not be sustained after the finger was removed from the key. By Messrs. Kirkman's new invention, the same note can be made to sound for a lengthened period at the will of the performer. To accomplish this object a double set of hammers is required; these are fixed by delicate watch springs to a hollow brass rod, extending nearly the entire length of the instrument, and they are set in motion simultaneously by a treadle action of an additional pedal. This treadle causes a fly-wheel to revolve at any required speed, which in its turn communicates a vibratory motion to the brass rod upon which the hammers are fixed. An action similar to that of a row of electric bell-hammers is now set up, but somewhat short of striking distance from the strings; but on pressing down a note on the key-board, however softly, the

handle of the still vibrating hammer is depressed, and, coming in contact with the wire, produces the effect of either a *tremolo* or a sustained note, in proportion to the speed with which the treadle is worked. Thus it will be seen that the *tremolo* would have a soft, and the sustained, a loud tone, so that here the additional advantage of a swell is attained, as perfect as that effected by the expression stop of the harmonium.

The manipulation of the keys for the melo portion of the instrument is precisely the same as the creeping movement required for the organ, excepting when it is desired to add the force of the regular hammers, when the movement would be that in use for performance on the piano. The amount of volume of sound produced when the instument is put to its full power is perfectly astonishing, though perhaps not more so than the suddenness with which it can resume the softness of a dulciana and stopped diapason effect on a small organ. The quality of tone is difficult to describe, as, although a stringed instrument, the melo-piano partakes very much of the tone of a harmonium; its full beauty can, however, only be appreciated by hearing its effect. Its introduction certainly should mark the commencement of a new era in piano manufacture.

The second improvement in existing arrangements, to which we refer, relates to organ pipes, which at the present time give out but one note each on the reed being acted upon in the ordinary way. But there is no reason why an organ pipe could not be rendered as capable of giving out as many distinct notes as a flageolet or flute, by merely attaching to it a series of valve stops at certain intervals throughout its entire length, their action being as easily controlled by the player as the key notes of the lesser instruments we have named.—*Industrial Art.*

—The Persian carpets in the Paris Exhibition are said to be very wonderful, some having been made three hundred years ago, and looking to all appearance not, indeed, "as fresh as paint," because that gives an impression of gaudiness, but as good as ever. Some of them have been in constant use for the time above named, and are even now by no means shabby. They are woven in hand looms on a web of cocoon silk prepared with certain alkaloids which insure them against the moth. "The wool forming the pile is knotted many times before the loop giving it the velvety appearance is cut. As each knot is made it is hammered flat. A live coal might fall upon this carpet and remain on it for some moments without leaving an indelible mark, so deep are the strata of loops and knots." They are the handiwork of wretchedly poor weavers, who have probably received more kicks than half-pence for their pains.

A WATER COOLING FAUCET.

This faucet, through which water is drawn as cold as ice, is the invention of a Californian. Boiling water placed in any receptacle and allowed to run through, will be found cool and fit to drink. The faucet contains numerous

small tubes enclosed in larger ones, and between the outside of one and the inside of the other chemicals are packed which produce the desired effect. For these chemicals it is best to use simply nitrate of ammonia, moistened with water; the cooling effect will last until all the nitrate is dissolved, when it must be renewed. The salt may afterward be regained from the solutions by evaporation, and can be used over and over again for an unlimited time.—*Manufacturer and Builder.*

ANCIENT SOAPSTONE QUARRIES.

Prof. Baird, of the Smithsonian Institution, is preparing to send, within a few days, one of the scientific specialists in his employ into Virginia, to prosecute the archæological investigations begun under the auspices of the Institution. The region of the investigation lies in Amelia county, about fifty miles south of Richmond, where there have been discovered quarries of soapstone, or steatite, which appear to have been worked by the aboriginal inhabitants of the continent. Extensive traces have been found of these ancient quarries, out of which were procured the pots and various domestic vessels used by the aborigines of this region. A great number of specimen articles have been obtained already and brought to Washington. The examinations which have thus far been made, prove that the quarries were abandoned at least four hundred years ago, there being found in them no vestige of iron or other metal implements, while the remains of the various implements with which they were evidently worked are abundant. A forest of pine and oak has also overgrown the site of the ancient excavations, the trees, in some instances, being nearly two feet in diameter.

The pots which were taken by the early Indians from these beds of steatite appear to have been carved with the bottoms upward, and then broken from the rock. The evidences of their having been so obtained are numerous, the vessels being found in every stage of completion in the bottoms of the quarries. The spot in the quarry at which the original excavations were begun has also been ascertained, and by an examination of this and the subsequent workings, the steps of progress in the art of excavation and of shaping the pots has been made obvious. In the beginning, the excavators appear to have employed their ordinary stone axes, as is seen from the number of these broken instruments at a single point in the quarry. As the traces of these implements are found nowhere else in the excavation, it is inferred by Professor Baird and his assistants that this mode of quarrying was given up as being too costly, the labor of making a single stone ax to replace a broken one being in itself the work of years. Later the pots seem to have been quarried with flint adzes, fashioned especially for the purpose out of a neighboring flint ledge. The site of this ledge has been found, and numerous adzes procured from it are strewn everywhere in the quarry. In addition to these facts, there are other interesting details of this discovery which will be given for publication after the return of the expedition, which is to be made for the purpose of ascertaining the full extent of the excavations, and for observing more closely the traces of the ancient people who made them.—*N. Y. Tribune.*

MEDICINE AND HYGIENE.

DISEASES OF THE EAR FROM BATHING.

Under this heading, Dr. Samuel Sexton, of the New York Ear Dispensary, communicates to *The Medical Record* an elaborate and instructive paper on the dangers of sea-bathing. He attributes many cases of aural disorders and partial or total deafness to the incautious manner in which many bathers battle with the surf, dive under water, and expose themselves to the cold wind, permitting the hair, ears, etc., to dry by evaporation.

The following conclusions sum up the substance of the article and afford sound advice for sea-bathers:

"The ear is far oftener the seat of inflammation and resulting deafness from bathing than is generally supposed. Although its delicate parts occupy a deep situation in the skull, which is usually a protection from objects capable of injuring it, yet in any bathing which includes immersion of the head, it is liable to be more or less damaged.

"This damage consists in the admission of water into the ear, either through the external auditory canal, or the Eustachian tube.

"When water finds admittance to the former, if cold or salt, inflammation of the meatus alone may result, or if violently injected, as in surf-bathing, or long retained in the canal from diving, the disease may affect the drum-head and middle ear.

"Whenever water is forced from the mouth and nostrils into the middle ear through the Eustachian tube, inflammation of the middle ear is almost sure to occur, even though the water be warm. This has been frequently illustrated in a most painful manner by those who have been induced to use the popular nasal *douche*, inflammation of an acute purulent character having frequently been thus established, which has been dangerous to the life of the patient, and after a tedious recovery left great deafness behind.

"Frequent exposures, especially in salt water bathing, may be the cause of slight ear-aches, which are usually neglected as unimportant, but which are frequently the precursors of much deafness.

"The fact that several thousand severe cases of aural disease thus result annually in New York city alone, should be a serious admonition to all who are concerned; and that three of the sixty-five cases here reported had dangerous cerebral complications, should be a further warning.

"That bathing is pleasant and healthful is of course admitted, but that it cannot be practised, as at present, without danger, is undeniable. It has been shown here by a glance at natural history that amphibia, whose life is passed indifferently in either air or water, have naturally the means of protecting their auditory apparatus; but man is not so constructed, and therefore he cannot with safety practice diving or submerging the head.

"He should never dive if he wishes to preserve his hearing.

"When in the surf he should take the water upon his chest or back, closing the mouth and nostrils, being careful not to present the ear to the incoming wave.

"It is equally dangerous while swimming to receive dashing water into the mouth or nostrils. A firm pledget of cotton-wool in the ears is some protection. Drying the hair and body and dressing quickly after the bath are, of course, necessary precautions.

"The neglect to observe care in bathing is well illustrated by the four cases of aural disease, which I have presented here in the addendum as originating from the Russian bath, two of the attacks happening to physicians. This should point to the necessity of our always putting a patient, advised to use any kind of a bath, upon his guard as regards the danger to the ear."

RESULTS OF INTERMARRIAGE.

Mr. George Darwin, after searching investigation, concludes that "the widely different habits of life of men and women in civilized nations, especially among the upper classes, tend to counterbalance any evil from marriage between healthy closely related persons." Mr. Darwin's views are in a measure sustained by Dr. Vorni's inquiry into the commune of Batz. Batz is a rocky, secluded, ocean-washed peninsula of the Loir Inferieure, France, containing over three thousand people of simple habits, who do not drink, and commit no crime. For generations they have intermarried, but no cases have occurred of deaf-mutism, albinism, blindness, or malformation, and the number of children born is above the average.

HUNGARIAN LINIMENT.

Camphor pulv	40 parts.
Pimento pulv	20 parts.
Flour of mustard	40 parts.
Bruised garlic	20 parts.
Cantharid. pulv	10 parts.

These ingredients are digested for twenty-four hours in—

Vinegar	85 parts.
Rect. spirits	100 parts.

For frictions in cholera (Bouchardat.)

Cubeb Berries for Catarrh.—A new remedy for catarrh is crushed cubeb berries smoked in a pipe, emitting the smoke through the nose; after a few trials this will be easy to do. If the nose is stopped up so that it is almost impossible to breathe, one pipeful will make the head as clear as a bell. For sore throat, asthma, and bronchitis, swallowing the smoke effects immediate relief. It is the best remedy in the world for offensive breath, and will make the most foul breath

pure and sweet. Sufferers from that horrible disease, ulcerated catarrh, will find this remedy unequaled, and a month's use will cure the most obstinate case. Eating the uncrushed berries is also good for sore throat and all bronchial complaints. After smoking do not expose yourself to the cold air for at least fifteen minutes. The berries are perfectly harmless, and there is no use in going to a "catarrh doctor" while you can procure this remedy. They can be got at any drug store.—*Chicago Tribune.*

A Remedy for the Eruption Produced by Poison Ivy.—Dr. S. A. Brown, U. S. N., writes to the *Medical Record* that he has found in bromine a specific to the eruption produced by the poison-oak or poison-ivy. He says that he has used it with unvarying success in at least forty cases. The eruption never extends after the first thorough application, and it promptly disappears within twenty-four hours, if the application is persisted in, and the patient is entirely cured. He uses the bromine dissolved in olive oil, cosmoline or glycerine, in the strength of from ten to twenty drops of bromine to the ounce of oil, and rubs the mixture gently on the affected part three or four times a day. The bromine is so volatile that the solution should be renewed within twenty-four hours from its preparation.

BOOK NOTICES.

The Commonwealth of Missouri—A Centennial Record, Edited by C. R. Barns. St. Louis, Bryan, Brand & Co., 1877, pp. 936, large octavo. Cloth, $5 00.

This work, prepared in accordance with the suggestion of President Grant, at the opening of the Centennial year, was expected to be completed by the close of that year, but its magnitude prevented and it has only been ready for distribution a few months. Its principal contributors are A. J. Conant, the well-known artist of St. Louis, who furnished the excellent article (122 pages) on Archæology; Col. W. F. Switzler, the veteran editor of Missouri, who has ably writen up the Historical section; Prof. G. C. Swallow, formerly State Geologist, who contributed the article on Physical Geography; R. A. Campbell, that on the Material Wealth of the State; Prof. W. T. Harris, who naturally and fitly took charge of the subject of Educational Progress, and other writers who furnished the numerous biographical sketches of the more or less distinguished men of the State. It is a valuable work and one that reflects credit upon its publishers, as well as upon those whose literary ability and artistic skill made up its subject matter.

Studies in Luke—Reprinted from the "Emphatic Diaglott." By Benjamin Wilson. New York, S. R. Wells & Co., pp. 160, 12mo. For sale by M. H. Dickinson, successor to Matt. Foster & Co. 60c.

This little brochure is separated from the main book, ("The New Testament in Greek and English," by the same author), for the use of teachers and others in connection with the International Sunday school lessons for the third and fourth quarters of 1878. It is put into a very compact and convenient form, and, as the arrangement given will show, cannot fail to be of great service to all students of the New Testament, whether acquainted with the Greek language or not. Its peculiar features are an approved Greek text with the various readings of the Vatican manuscript, No. 1,209; an interlineary, literal, word for word, English translation; a new version on the margin of each page, with the signs of emphasis; a copious selection of references; many appropriate, illustrative and exegetical foot-notes, and a valuable, alphabetical appendix of names, weights, measures, &c. We quote a few lines from the preface: "The intelligent reader will at once perceive the utility and importance of this arrangement. Readers who are familiar with the original tongue obtain in this work one of the best Greek Testaments, with important ancient readings, well worthy of their attention; and it is presumed that there are even few Greek scholars, who are so far advanced but may derive some help from the translation given. Those who have only a little or no knowledge of the Greek, may, by careful reading and a little attention to the interlineary translation, soon become familiar with it. This work, in fact, places in the hands of the intelligent English reader the means of knowing and appropriating to his own benefit, with but little labor on his part, what has caused others years of study and some toil to acquire." The typographical execution, both of the Greek and English portions, is admirably clear and perfect, and, as before suggested, it cannot but be an excellent aid to students of the New Testament. The whole work, gotten up upon the same plan as this book of Luke and containing eight hundred and eighty-four pages, sells for $4.00.

THE PACIFIC RAILROADS, (Illustrated), pp. 95, octavo, paper cover. New York, D. Appleton & Co., 1878. For sale by M. H. Dickinson, successor to Matt. Foster & Co., 75c.

Of all the hand-books for travelers that have fallen under our notice this season, this is by far the most complete and attractive, describing and portraying as it does the most picturesque and interesting portion of the United States, with unusual fidelity and care. The writer and artist have both taken great pains with their work and the result is a graphically prepared book illustrated with a map and nearly one hundred beautiful engravings. All who live in the West and have visited many of the localities depicted and described, will bear ready testimony to the truthfulness of both letter-press and illustrations, while those who have not will readily recognize in this work the handiwork of skilled observers and artists, to which is added the unsurpassed excellence of the Appletons in book-craft.

To such tourists as design visiting the Rocky Mountains this summer, and especially to such as have not visited them before, the work will be a most useful guide and companion.

THE NATURALIST'S DIRECTORY FOR 1878.—Edited and published by Samuel E. Cassino, Salem, Massachusetts, 1878; pp. 200; price $1.00.

This is an important work for naturalists, as it furnishes the names of more than two thousand and five hundred scientific men of the United States and Canada, arranged alphabetically and by departments; also a list of scientific societies and a catalogue of obtainable scientific books, arranged by subjects. This work has been done by Mr. Cassino with the assistance of Miss S. E. Brooks, Prof. Eaton, of Yale College, Prof. Goode, of the Smithsonian, Prof. Ward, Prof. H. Carrington Bolton and other naturalists of high standing, and as far as our examination has extended it has been thoroughly done. If no other object were attained than the putting into possible communication with each other the students of similar departments of science, the book would be worth much more than its price to them.

CATALOGUE OF THE UNIVERSITY OF CINCINNATI, 1878–9; pp. 104.

The University consists of three departments: The Academic, or department of Literature and Science, the School of Design and the Observatory. It is amply endowed and supported, and the course of study in the different departments is most comprehensive and thorough. Its cabinets and collections of minerals, fossils, etc., are unusually extensive and complete, as are also its apparatus for teaching and studying astronomy, mathematics, chemistry, &c. Its plan of instruction seems admirable, and the history of the institution shows that it has been remarkably fortunate in its Professors and successful in all its departments.

ON THE DIRECT PROCESS OF MAKING WROUGHT IRON AND STEEL.—By Chas. M. DuPuy, C. E., No. 4102 Spruce street, Philadelphia; pp. 12.

This is a reprint of a paper read by the author at the meeting of the Franklin Institute, October 17, 1877, which has attracted much attention among technologists. The "direct" process invented by Mr. DuPuy seems in brief to consist in placing the crushed iron ore, mixed with carbon and fluxes in proper proportions, in annular cylindrical sheet iron canisters and melting in ordinary reverbatory furnaces, into masses of metal which are transferred to the squeezer, made into blooms and rolled to muck bar without re-heating. The process meets the approval of some of the best manufacturers in the country and doubtless is a vast improvement, when fully perfected, over any now practiced.

LIFE: ITS PERILS AND SALVATION.—By Hon. S. S. Cox, M. C.; pp. 24.

The above is the title of a most eloquent and convincing speech made in the House of Representatives, June 4, 1878, in favor of the Life-Saving Bill, then under consideration. Mr. Cox has devoted much of his time for the past ten years in Congress to the humane and public-spirited object of rendering the merchant marine, and other branches of our naval service, less dangerous to human life; and to his skill in legislative work, pertinacity and earnestness in urging the importance of the matter at all times, is due the comparative efficiency of our coast life-saving service, more, probably, than to the efforts of any other man in Congress.

CENTENNIAL CELEBRATION AT SANTA FÉ, NEW MEXICO, July 4, 1876; pp. 64, octavo.

We are indebted to Major David J. Miller, chief clerk in the office of the United States Surveyor-General of New Mexico for the above-named pamphlet, containing, among other interesting items, an historical sketch of Santa Fé, by Major Miller, in which the author contends that Santa Fé is really the oldest settled town in the United States, not excepting Saint Augustine, Florida. This is a most valuable paper and we hope at some future time to make copious extracts from it, as important contributions to the history of that little known portion of our country.

EDITORIAL NOTES.

KANSAS CITY ACADEMY OF SCIENCES met at its rooms on the evening of June 25, with the expectation of hearing Dr. Heath of Wyandotte, on "Peru and its Antiquities;" but owing to a sudden illness the lecturer was unable to be present, and the audience was disappointed. Dr. Fee, of this city, however, read a carefully prepared paper upon the "Material Basis of Life," which was listened to with marked attention. Mr. Eccles, of Brooklyn, New York, a writer and lecturer of note, made a few remarks on the same subject.

After transacting some miscellaneous business the Academy took a vacation until the regular day of meeting in September.

PROF. E. C. CROSBY, of the public schools of this city, with his brother, Prof. A. B. Crosby, is giving a series of Natural Science lectures before the Teachers' Institutes of Kansas, during the summer vacation. They are well provided with apparatus and other means of illustration, and from their well known ability and knowledge of the subjects to be treated, our Kansas friends may rely upon an interesting and instructive course.

A FEW weeks since Mr. Sargent, who has secured the sole right to exhibit Edison's Phonograph in the State of Kansas, brought the instrument to this city and gave a free exhibition to the editors of the city papers, at the Pacific House. The exhibition was a decided success, the instrument receiving and repeating songs, speeches, and other musical and unmusical sounds very perfectly.

It was quite observable that it repeated high, sharp, explosive notes, such as those produced by whistling and shouting, more exactly in the same key than those produced by singing tunes in a slow and prolonged manner. For instance, it reproduced the words and notes of "Ninety and Nine" far more truthfully than those of a German "warble" where the notes were prolonged and run together by the singer, and a tune whistled into it came back exact.

It was quite a treat and all heartily thanked Mr. Sargent for his courtesy in coming over the line for our edification.

THE value of the Mexican dollar as fixed by the Government January 1, 1878, was 99.8 cents. It is received by Government at that rate. There is no reason, therefore why the Mexican dollar should not pass in ordinary business the same as our dollar of 412½ grains. Its bullion value is greater, and the two mills depreciation by Government is inappreciable in small transactions.—*Cor. St. Louis Times.*

PROF. SPENCER F. BAIRD, successor to Prof. Henry, as Secretary of the Smithsonian Institute, is one of the few men of note and position who has earned both by constant,

steady, intelligent personal work and study. From the day of his graduation at Dickinson College, Pa., until now he has been actively and laboriously occupied in the various branches of science to which he has specially devoted himself, and his promotion has been the direct result thereof.

In 1846 he was appointed Professor of Natural sciences in Dickinson College, where he had so recently been a student. In 1850 he was appointed Assistant Secretary of the Smithsonian Institute. In 1871 he received the additional appointment of Commissioner of Fish and Fisheries, and in 1878 the distinguished position of Secretary of the Smithsonian Institute, so long and ably filled by the lamented Henry.

His scientific researches have extended in many directions, but have been mainly confined to the mammals, birds, fishes and reptiles of North America, which, from his exhaustive investigations and descriptions, are now better known than those of almost any other country.

His literary labors have been extensive and continuous, embracing Translations of scientific works from the German; Reports on the Mammals of North America in connection with the Pacific. R. R. surveys; a work on the Birds of North America in 1864; a "Review of American Birds," published under the auspices of the Smithsonian; also a work on the Birds of North America, with Dr. Brewer; also several Reports upon Fishes and Fisheries, including Inquiries into the decrease of the supply of food fishes in the U. S., and a number of minor papers on various kindred subjects, which have been published in the proceedings of the Philadelphia Academy of Science, the New York Lyceum of Natural History, etc. One of the most valuable works with which he has been connected is the Annual Record of Science and Industry, of which he is editor, and which has been published by him for the past eight years with the assistance of several leading scientists of the country.

While in college Prof. Baird was a classmate of Prof. Theo. G. Wormley, one of the most skillful and competent chemists in the United States, who also has risen to a prominent position—that of Professor of Chemistry in the University of Pennsylvania, by constant untiring study and labor.

If the results of the boring for coal at Rosedale are as indicated by the report made by Dr. Thorne, on page 210 of this number, it will be a very important "find" for Kansas City. We have inspected some of the coal dust brought up by the auger, and as far as we can judge from such specimens, it is of good quality, besides which, the gas, if it proves permanent, will be very valuable.

We were favored with a call from Prof. Moss, of the Colorado School of Mines, last week. He states that the school is growing in public favor, and that next summer the Faculty will probably inaugurate a series of excursions into the Mountains for the purpose of teaching the students geology, mineralogy and practical mining. This will be an attractive feature, and will add greatly to the advantages already possessed by the school in its proximity to the smelters and refiners at Golden, Georgetown, &c.

The *Scientific American Supplement*, one of the best practical scientific periodicals in the country, has done us the honor to reprint quite a number of articles from the Review lately, including those by Profs. Pritchett and Crosby, Mr. Stevenson and Miss Murdfeldt.

Professor Arthur Lakes, of Golden City, Col., has promised to furnish several original articles for the Review very soon, founded upon his own experience in Palæontological explorations. The Professor is an ardent explorer and a good writer, so that our readers may look for something both entertaining and instructive.

Col. H. Inman, of Larned, Kansas, promises an article for the September number, upon "The Works of the Mound Builders West of the Missouri River."

Dr. Heath, having recovered his health, will soon be ready to deliver his lecture on "Peruvian Antiquities," of which due notice will be given.

MR. A. J. CONANT, in his comprehensive article on "Missouri Archæology," in the *Commonwealth*, already noticed among our "Book Reviews," quotes liberally from the articles of Judge West and others, published last year in the REVIEW, besides sending the editor a complimentary note regarding them.

THE American Association for the Advancement of Science, Meets at St. Louis, August 21, 1878.

WE give in the following table a comparative view of the temperature at Kansas City during the month of July, for the years 1876, 1877 and 1878.

	1876.			1877.			1878.		
	7 a.m.	2 p.m.	10 p.m.	7 a.m.	2 p.m.	10 p.m.	7 a.m.	2 p.m.	10 p.m.
July 1st	68	73	63	76	75	76	67	78	66
2d	68	74	74	76	84	75	68	77	66
3d	80	82	77	77	76	76	68	77	69
4th	77	84	79	81	84	80	67	78	85
5th	74	82	76	83	90	81	80	87	74
6th	82	85	77	78	92	82	80	87	75
7th	83	88	78	87	92	81	82	85	77
8th	81	83	76	86	92	82	68	83	76
9th	74	83	75	72	84	74	76	86	78
10th	73	81	74	76	83	70	81	92	78
11th	81	83	78	70	80	65	81	90	80
12th	81	89	78	71	78	66	83	92	82
13th	75	90	74	71	82	71	84	92	82
14th	73	83	72	72	86	75	89	94	82

ITEMS FROM THE JULY PERIODICALS.

AMONG so many interesting items as are always furnished by the *American Naturalist*, it is embarrassing to attempt to indicate the best. Probably, however, the article upon "Diamonds," by F. M. Endlich, would most interest the general reader, while that upon the "Mound Making Ants of the Alleghenies," by the Rev. Henry McCook; or that upon "The Smallest Insect Known," by Gen. J. D. Cox, with their minute and technical descriptions, would best please the naturalist. There is nothing in the whole number that is not both entertaining and instructive, and the General Notes are remarkably well condensed and arranged.

THE *North American Review* contains no articles in its July-August issue that can be classed as scientific; but from a literary point of view it is fully equal to any that have preceded it. The essay by Mr. W. B. Lawrence upon "the International Obligations of the United States," is a tersely written and comprehensive article, intended to clearly define the rights of the United States in case of a war between England and Russia. That entitled "An Advertisement for a New Religion," is a combination of irony, sarcasm and indirect argument which it will trouble the evolutionists and positivists to answer, even though written ostensibly by an evolutionist.

IN *Popular Science Monthly* we find, among many good articles, one on the "Radical Fallacy of Materialism," which is notable from its intrinsic merit, as well as from the fact that its author, Mr. Eccles, is a former resident of this city.

The *International Review* gives us an article on the "Chinese Puzzle," by a citizen of San Francisco, in which the subject is remarkably well handled from every point of view. It deserves the attention of our Congressmen and State law makers.

THE *Scientific American* commences its 39th volume with the issue of July 6th. It has a deservedly wide circulation among all classes, especially among those engaged in mechanical occupations.

THE *Manufacturer & Builder* is also devoted to practical matters. The present number contains good articles on Architecture, Engineering, Building Materials, Ballooning, &c., original and selected.

THE leading articles in the *Boston Journal of Chemistry* are upon the Microphone, the Telegraph in Olden Times, and House Building, while the miscellaneous items are various, numerous and valuable.

THE *Polytechnic Review* devotes several pages to the Paris Exposition, the Old and New way of transporting Goods and Passengers in Pennsylvania, the Development of Photo-chemical processes, &c., &c.

THE *Phrenological Journal* gives phrenological and historical descriptions of the Hon. Carl Schurz and Mrs. Almira L. Phelps, also, the usual amount of interesting miscellaneous articles on popular subjects, medical, physiological and otherwise.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. AUGUST, 1878. NO. 5.

ASTRONOMY.

PERSONAL OBSERVATIONS OF THE ECLIPSE.

BY EDWIN R. WEEKS.

EDITOR OF THE WESTERN REVIEW:

In compliance with your request I inclose a few hurried remarks on the recent solar eclipse as seen from Denver. A few general remarks in regard to the phenomena of solar eclipses may not be out of place. Solar eclipses are either *partial*, *annular* or *total*, and by virtue of the inclination of the orbit of the moon to that of the earth, can occur only when the *new* moon is at or near one of her *nodes*. When the moon's position is such that only a part of the sun's disc is hidden from view, the eclipse is partial; when the moon is at or *very* near one of her nodes, and her disc is not large enough to cover that of the sun, leaving a ring of his disc visible around her dark body, the eclipse is annular; when the moon is at or quite near one of her nodes and presents a disc equal to or larger than that of the sun, the eclipse is total. These last conditions were fulfilled in the eclipse of to-day. The change in the apparent relative diameters of the two bodies is due to the elliptical form of the orbits of the moon and earth.

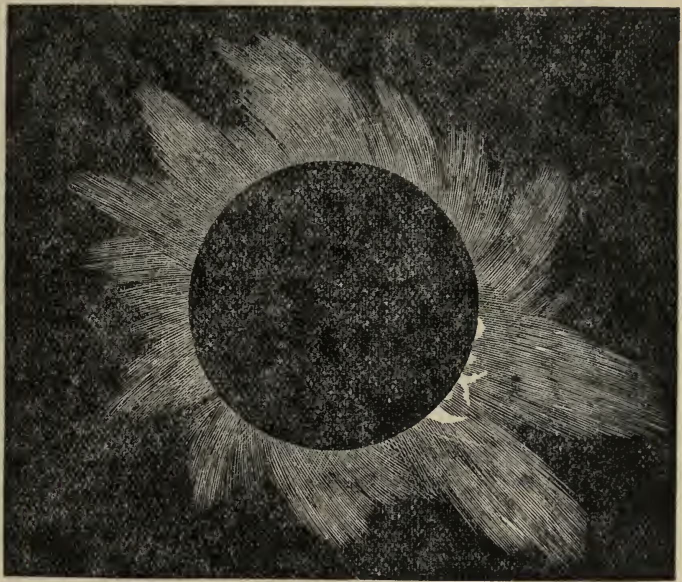
A total eclipse derives its importance from the opportunity it affords for testing the accuracy of the lunar tables, from its being the only time when the solar appendages can be subjected to investigation, and also from its being the only time when the intra-Mercurial space can be searched for the mythical (?) Vulcan.

For several weeks prior to to-day there had not been a day suitable for observation at this place. Many mornings dawned beautifully clear, but towards noon, with provoking regularity, billows of cumulous clouds rolled down from the mountains and hovered over our fair city like birds of ill omen, reducing to zero the hopes of astronomers, rousing the ire of many of our citizens and exciting the anxieties of all. But, despite the unpromising days preceding, to-day has proved all that could be desired, being absolutely free from clouds up to one o'clock p. m., and substantially so throughout the entire day. The only clouds to be seen were a few light ones of the cirrus and cumulous orders that hung nearly stationary about the snowy range, causing little if any uneasiness. During the afternoon a cool breeze blew steadily from the southeast with just enough force to refresh without interfering with careful observation.

The eclipse has been the almost exclusive theme of conversation in Colorado for many days. The masses at last seem to be gaining an inkling of the true import of such an event, for cheering interest was manifested on every hand by intelligent remarks, enthusiastic preparation for observation and sincere wishes for success. It seems that intelligent interest in phenomena of this class is surely becoming more general—a fact full of encouragement for our astronomers.

In seasonable time, armed with a refractor three inches in aperture and accompanied by an assistant, we repaired to "Capitol Hill" to join the party of Prof. W. E. Lyford (Professor of Physics in Colby University). Putting everything in readiness we waited expectantly for the eclipse to begin. The Signal Service telegraphed that the time of *first contact* would be 2:16, Denver time. Some one fond of a joke posted a notice in the post office (purporting to be the latest "official" from the Signal Service) to the effect that the moon had been delayed three hours by a " washout on one of the railroads. Although not detained by a " washout," the moon certainly was about three and one-half minutes behind the Signal Service time, during which delay we strained our eyes most painfully, watching to note the second of first contact, which did not occur until 2:19.31, p. m., Denver time. Profs. Lyford and Colbert (of the Colby and Chicago Universities, respectively) each computed the time of commencement and agreed in making it 2:19.20, a much nearer approximation; in fact, within 11 seconds of the actual observed time. After noting the time and point of first contact, we concluded to prepare our eyes for effective work during the all-important *totality*, by resting and looking about us. To the south was the Princeton party under Prof. Young; to the west the Chicago party in charge of Profs. Colbert, Hough and Swift; to the north and northwest were several parties, the more noted of whom were the party sent out by the Chicago *Times*, under Prof. Burnham; the party from Woodstock University, under Father Sistini; and the Vassar party, in charge of Miss Maria Mitchell. As the light diminished, objects, from persons standing near, to the city with its roofs covered by observers, and beyond to the deceptive foot-hills and fickle mountains, everything, appeared gloomy, weird and unnatural. As the time of totality drew near all eyes were turned in the direction of Long's Peak to note the approach of the eclipse shadow. The mountain was al-

most hidden from view by a number of light, silvery clouds, that, as the shadow approached, were instantly transformed to a delicate purple. Warned by this beautiful token, all made instant preparation to observe the phenomena of totality.



Sketch of Corona and Protuberances as they appeared during the latter part of totality. The prominences are exaggerated in order to more clearly show their peculiar shapes.

The time of *second internal contact* (beginning of totality) was 3:29.4. At the instant of contact the Corona flashed into view. Its light was of the purest, silvery white, unsullied by any other tint, and faded gradually from the greatest brightness at its base to the faintest silvery thread, barely perceptible on the deep violet back-ground of the sky. Its light seemed constant; could detect no fluctuation whatever. Its general structure was radial, not nebulous. Individual rays could be traced throughout their entire length. In the direction of the ecliptic the rays were mostly straight and coincident with the sun's radii prolonged, although some curved quite notably, intersecting others at various angles. But by far the more interesting and peculiar features were the distinctly spiral polar extensions, remarkable for their length and decided curvature. This was especially true of the rays springing from the upper limb, some of which, at first glance, seemed almost tangential, but a careful observation revealed the fact that the greatest angle formed by any with prolongations of the sun's radii at their bases could not exceed 30° or 35°, which, of course, would form very respectable secants.

The greatest extent of the corona was from the western limb in the direction of the ecliptic, and was a trifle more than a semi-diameter of the sun. From the eastern limb the extent was not so great, while from the upper and lower limbs it was least, being rather greater than the sun's semi-radius. Owing to the grad-

ual diffusion of its light it was impossible to determine the exact extent of this beautiful, flashing appendage, the delicate, subtile nature of which may possibly be more fully understood when we observe that we saw Delta-Cancri, a star of the fourth magnitude, shining through its substance. However, we estimated its greatest height at rather more than 500,000 miles. The beautiful phenomenon known as "Bailey's Beads," was observed for three or four seconds at the beginning and end of totality. These delicate objects appeared as somewhat irregular globules of light, intensely brilliant, tending, by their general appearance and duration, to strengthen the popular theory that they are caused by the lunar mountains dividing into fragments the slender threads of the *chromosphere* visible at the beginning and end of totality. A few seconds before the close of totality, the beautiful ruddy layer of glowing hydrogen called the chromosphere sprang into view, extending along the western limb about 120°, and remaining visible about six seconds, when it was shivered into as many as 35 or 40 fragments (Bailey's Beads), altogether forming one of the most beautiful and never-to-be forgotten sights ever witnessed by the writer.

The well-known solar protuberances were neither so numerous or prominent as on former occasions, only five being seen, protruding from that part of the sun's western limb near the point of first contact. Two of these were quite prominent and clearly defined, the others were small. The first in size was broadest at its base and tapered to a fine point at its extremity, which was strongly curved to the north, giving it a shape much like that of a horn. We estimated its height at fully 45,000 miles. The second, from a more narrow base, spread to a point where it divided into two forks, which, with their minor offshoots, presented a decidedly unique figure, somewhat resembling the antlers of a deer. These prominences seemed perfectly quiescent. As the dark body of the moon passed on, revealing successive parts of the largest one to view, its color was seen to range from the purest white at its extremity to a delicate pink in the center, merging into a rich rose color at the base.

Our search for Vulcan proved unsuccessful. The darkness was not so great as we expected, although chickens sought their roosts and Mars, Venus, Mercury and several of the brighter stars were conspicuous objects to the naked eye.

As totality closed we glanced regretfully after the dusky shadow, gliding swiftly away to greet the eager eyes of other observers posted along its path. The time of the *third internal contact* (end of totality) was 3:31.45. The temperature fell perceptibly during totality but quickly recovered, reaching its *maximum for the day at 5:10 p. m.* The *fourth external contact* (end of the eclipse) took place at 4:35 p. m.

Many attribute the remarkable fitness of to-day to the proverbial devotion of astronomers, for has not the assertion of the poet Young that "an undevout astronomer is mad," passed into a proverb? With all possible respect for Young, and a firm belief in the strong tendency of astronomical research to develop veneration for the Creator, the Great First Cause, the "Eternal One, whose presence bright all space doth occupy, all motion guide," we still venture the opinion that if

to-day had proved cloudy, this evening's prayers of the scores of astronomers in Colorado, if not entirely neglected, at least would not be offered in "spirit and in truth." We are confident that the members of our party would feel very wicked. But, as it is, the feeling of gratitude is general, and belief in special Providence is greatly strengthened.

Denver, Colorado, July 29th, 1878.

THE SOLAR ECLIPSE OF JULY 29, 1878.

PREPARED BY THE EDITOR.

It seems quite certain that the eclipse of July 29th was not as fruitful of important results to the scores of learned and skilled astronomers from the observatories of Europe and America, who were present at various points along the line of its totality, as was expected; nevertheless, many valuable observations of the corona, protuberances, intra-Mercurial planets, and other objects of scientific interest were made which will in due time be given to the public.

In the mean time we herewith give a condensed statement made up from the verbal reports of eye witnesses and from the special telegrams sent to the daily papers of St. Louis, Chicago and this city.

An appropriation of $8,000 having been made by Congress for the purpose of aiding the official observation of this eclipse, Admiral Rogers, Superintendent of the U. S. Naval Observatory, sent out five parties from various colleges and observatories, under command of professors of Mathematics in the navy and officers of the line.

The following is a complete list of the parties sent out or assisted by the observatory, their instructions and their proximate points of observation: Prof. S. Newcomb, Commander W. T. Sampson, Lieut. C. G. Bowman and John Meier were located at Creston, Wyoming, with instructions to photograph with one of the photo-heliographs used in photographing the transit of Venus in December, 1874. Also to observe contacts and look for intra-Mercurial planets. The following party was stationed at Pueblo, Colorado: Prof. A. Hall, Prof. J. A. Rogers, Prof. A. W. Wright, Mr. H. F. Gardner and Mr A. B. Wheeler, to take photographs of the eclipse, corona, and all around it that could be gotten on a plate; make polariscopic observations of the light of the corona; observe time of contacts, and make a search for intra-Mercurial planets. The next party was located at Creston, Wyoming, and was made up as follows: Prof. Wm. Harkness, Lieut. E. W. Sturdy, Assistant Astronomer A. M. Skinner, Messrs. L. E. Walker, A. G. Clark and Prof. O. H. Robinson. This party had the same instructions as Prof. Hall's, except that instead of polariscopic observations they were to take spectroscopic and thermo-electric observations. At Pueblo, Colorado, there were stationed Prof. J. R. Eastman, Prof. Lewis Ross, Assistant Astronomer H. M. Paul, and Mr. H. S. Pritchett, son of Prof. Pritchett of Glasgow, Mo. This party was directed to take polariscopic observations, observe

contacts, search for planets, and make drawings of the corona. The following party was stationed at Central City, Colorado: Prof. E S. Holden, Lieut. T. W. Very, and Dr. C. S. Hastings. They were assigned to the mountains southwest of Denver, to search for planets, and investigate structure of corona.

Mr. L. Trouvelot, of Cambridge, Mass., a most skillful artist, accompanied by his son, was sent to Rawlings, Wyoming, to make a drawing of the corona; Prof. Edison was also at Rawlings. Mr. G. W. Hill, of the Nautical Almanac office, was stationed on one of the mountains in Colorado to make drawings of the corona. Prof. Ormond Stone, of Cincinnati, and Mr. Winslow Upton, of Cambridge, observed the eclipse from the lofty peaks of Colorado, at Schuyler. Gen. Myers and Prof. Abbe, of the Signal Office, and Prof. Langley, of Pittsburg, were stationed on the summit of Pike's Peak. They were obliged to take their instruments apart and carry them by hand to an elevation exceeding 14,000 feet. Mr. D. P. Todd, went to Texas and made arrangements for observing duration of totality near the limits of total eclipse at Dallas and other places. Many distinguished English astronomers and M. Jansen, the famous astronomer from Paris, were also at hand to observe the eclipse.

Profs. C. A. Young, C. F. Brackett, and C. S. Rockwood, of Princeton, N. J., with Messrs. W. Libbey, Jr., G. H. Calley, C. D. Bennett, W. McDonald C. J. Young, and H. S. S. Smith were near Denver, chiefly working with the spectroscope. Maria Mitchell, of Vassar, was also near Denver. Norman Lockyer, Dr. Schuster, Prof. J. C. Watson, of the Detroit Observatory, and Prof. Thorpe, of England, were in the same neighborhood, with the telespectroscope, and the last named gentleman made a series of meteorological observations at several points. The Chicago Astronomical Society was represented at or near Denver by three of its members, Prof. G. W. Hough, S. W. Burnham, and Prof. E. Colbert.

As will be seen, the utmost care was taken to select the most favorable points from which the observations could be made unaffected by bad weather or other terrestrial or atmospheric hindrances. Every facility for thorough observation was provided, and the work so divided up among the individual members of each party as to secure from each his undivided attention to the observation of particular features of the great phenomenon, thus securing the fullness and accuracy of detail so important in a scientific point of view. This was the first total solar eclipse that has been visible in this country since that of 1869, which received the attention of our astronomers and was fully observed. The eclipse of 1878 may be regarded as a return, or rather as a completion of the cycle of the eclipse of July 18, 1860. The dark shadow of the moon first struck the earth in Siberia and crossing Behrings Straits, the line of totality—which covered a space of about 116 miles wide—entered the United States at the northwest corner of Montana Territory, and moving in a southeast direction, swept over the Yellowstone Park, through Wyoming Territory, Denver, Colorado, Northern and Eastern Texas, and entering the Gulf of Mexico, between New Orleans and Galveston, crossed the islands of Cuba and San Domingo, and then left the earth. As the line of totality remained so long in this country, there was abundant time to observe all the many

curious and important phenomena connected with it. Much interest was attached to the eclipse by scientists, who looked upon it as the means of determining many vexed questions. First, and perhaps the most important, as it is of practical value to the navigator, were the corrections to be obtained to the present solar and lunar tables. Notwithstanding the remarkable accuracy already obtained, the location of the central line of the eclipse, as calculated by the American Nautical Almanac, differs by about four miles from that derived from the English Nautical Almanac. Important observations were also to be made respecting the physical constitution of the sun. The polariscope and the spectroscope were used to examine the corona of the sun during totality. As the duration of totality was not more than three minutes in the North, and two and a half in Texas, all the observers were required to work very rapidly in order to obtain the desired observations.

Advantage was taken of the sun's obscuration by the dark moon to examine the heavens in the neighborhood of the sun for Vulcan and one or more other small bodies that might be added to our solar universe. Besides this careful telescopic scrutiny, large photographs were taken of the heavens, in order to allow the small planets, if any there be, to print themselves upon the photographic plate, and thus announce to the world the fact of their existence and their influence upon the motions of their neighbor, Mercury.

The results of all these observations were reported to the *Chicago Tribune*, by Prof. Colbert, of the Chicago University, as follows:

The Chicago Astronomical Society observed from Capitol Hill, in Denver, commanding a magnificent view of the mountains to the northwest.

The first contact was at 2h. 19m. 30½s., local time. The second at 3h. 28m. 3½s. The duration of the totality was 2m. 40½s., being 3½s. less than the computed time. The last contact was at 4h. 35m., which shows that the moon's path was further south than calculated, or her diameter was estimated too large. We looked vainly for Vulcan, but there was too much light to see a small object so far away.

Prof. Thomas saw the line numbered 1,474, in the spectrum of the corona, but no new lines. The corona was much smaller than usual and measured an average of 26 minutes of arc from the moon, or 700,000 miles high. It was very pale, almost white. The corona was strongly striped in spiral rays thirty degrees from the direction of the radius. It flared most markedly in the direction of the ecliptic. Prof. Hough saw the chromosphere, extending some 3,000 miles from the sun's normal surface. There were very few protuberances and they were very pale. Two on the western side of the sun were the largest.

The scarcity of the red flames tends to confirm the theory of connection with the sun spots. This is near the minimum of the spots.

A class of about twenty citizens made drawings in this section, which will be compared and averaged at the Dearborn Observatory. Hawkins, of Denver, took several instantaneous pictures with the camera, which develop well and are very valuable.

Mr. Penrose, of London, England, was at Denver. He observed the landscape while the shadow was sweeping over it. He makes the time of totality two minutes forty-six seconds, but this probably included the duration of Bailey's beads, two and a half seconds, before totality, and the light, one and one-half seconds after, as seen by a Chicago Society party. Sergt. Barwick, of the Denver Signal Service, observed the sun. The thermometer fell from 114 to 82 during totality.

At Central City the observations were a decided success. The duration of totality was two minutes and fifty seconds. Prof. Young's party was fairly successful in observing the corona, and looking for Vulcan without finding him. They discovered no new lines in either the ultra red or the ultra violet. At the moment of totality all the Fraunhofer lines were seen brilliantly reversed, bursting out like rockets. Lines were seen near B, confirming Pogson's observations. They did not reduce the times of contact. One student saw a continuous spectrum with the interating spectroscope, and the line 1,474 was seen at the beginning and end of totality, but faded in the middle of the phase.

Mr. Raynard, of England, with Young, took two good photographs, but his driving clock got out of order.

Maria Mitchell's party saw the corona much more brilliant than in 1869, but the rosy flames were poorly marked. Saw Venus, Mars, Mercury and four stars, but no Vulcan. They made an oil painting of the corona.

Father Sistini, with a party from Maryland, saw the corona extend one and a half times the moon's diameter, and elsewhere half the same, making it the greatest measure seen.

Stone, of Cincinnati, near Denver, observed the contacts and measured the cusps.

The duration at Kit Carson was three seconds. It was not quite total at Greeley.

Prof. Louder, of England, saw at Denver, about one minute after totality began, a bright object like a star at a distance of twenty minutes of arc from the sun, and forty degrees from the north toward the east. It was visible till the total phase ended.

Swift, of Rochester, with the Chicago party, saw directly east of the sun two reddish stars, about three degrees from the sun and two minutes apart.

Do these observations show the existence of Vulcan? After all, Young and some other astronomers are more grounded in the belief that there is no Vulcan. This is the first time in eclipse history of stars seen and not known, and yet some doubt it is certain that the perturbations of Mercury can be accounted for by reference to cosmic matter which is inside the orbit of Mercury only at perihelion, and Prof. Hill, of Washington, has detected perturbations of the earth and Venus which accord with this view.

Profs. Eaton and White, of Brooklyn, located at Idaho Springs, report seeing Bailey's Beads, but no red prominences. The duration of totality was two minutes, forty-eight seconds.

From Denver, Col., Prof. Sistini reports: Toward the end of totality, observed some small continuous protuberances. There were streaks of light and shade on the ground preceding totality, a bright corona around the whole solar disc, with luminous offstarts on both sides in the direction of the motion of the moon, each extending about one diameter and a half of the sun, also two more offstarts nearly at right angles to the former, about half the solar diameter in length. The Vassar party report unimportant observations. They saw three planets and four stars. The Princeton party, the best supplied with improved appliances, made a special study of the structure of the corona and protuberances. Prof. Young reports very satisfactory results, but the discovery of nothing not before known to science. The corona was unusually faint and remarkable for its polar extension. No new bright spectral lines were visible in the ultra red or violet. All the Fraunhofer lines were beautifully represented in most instruments, the two H. H. strangely reversed. This is considered by astronomers quite remarkable. A good photograph was obtained of the corona. No new planets were discovered. Prof. Young expressed himself more than satisfied with the results of his observations. Prof. Louder reports, about one minute after totality began, a bright object like a star or planet was seen at a distance of 20 minutes from the sun's limit; position as seen in inverting telescope, 40 degrees to the right from the bottom of the field of view. It remained visible in the telescope till the end of totality. No known star or planet has ever been seen in this position.

Prof. Colbert's observations on the corona did not disclose any specially new features beyond the noting of the peculiar spiral character of coronal rays. Totality lasted 2 min, 40½ sec.; Bailey's Beads noticed 2½ seconds at the beginning of totality, and 1½ seconds at the end. Prof. Hough reports the entire phenomena presented entirely different in appearance to the eclipse of 1869, and to European eclipses of 1870 and 1875. Measurement of corona, 26 minutes, indicating diameter of solar atmosphere about 700,000 miles. Prof. Swift reports careful search for Vulcan without success. He saw, three degrees from the sun, two stars not down on the charts or star maps, and about as bright as the pole star, pointing directly toward the sun. A brilliant corruscation of light was seen on the moon's disc opposite protuberances.

Reports from twenty-five observing parties agree in the main particulars. No party has yet reported seeing the new planet observed by Prof. Louder. The spectacle was magnificent, and no doubt the observations taken, upon the whole will add largely to the world's fund of scientific knowledge.

The time of first contact was 2:20, Denver time, and ten minutes later the presence of the moon at the edge of the sun's disc was plainly perceptible to ordinary observers with smoked glass. By three o'clock the sunlight had moderated in a marked degree, showing a pale yellow color. Later on a lurid glare overspread the earth, the heat of the sun was no longer oppressive, and a light similar to twilight was shown in the horizon, and the light flecks of clouds began slowly to dissolve, owing to a change in the temperature. As the period of totality came on the sight from an elevated station was grand. An extreme dark

shadow fell on Long's Peak, seventy five miles distant, and sweeping rapidly southeastward, covered the plain like a gray pall. To the northeastward clouds could be seen bathed in sunlight, and presenting the view of a beautiful sunset. During the period of obscuration the moon appeared like a huge black ball.

At Rawlins, Wy., the weather was fine, the sky clear and the observations a perfect success. Dr. Draper, of New York, succeeded in obtaining several photographs of the sun during the eclipse. Prof. Watson of Ann Arbor, and Mr. Norman Lockyer returned early from Separation, where the total eclipse lasted two minutes and fifty seconds. Prof. Watson discovered an intra-Mercurial planet of the size of a four and a half magnitude star about two and a half degrees southwest of the sun. Mr. Lockyer says this eclipse was totally different from the one in 1871, the corona being ten times brighter this time, showing a great variation of the brightness of the corona between the maximum and minimum period of sun spots. He obtained a faint photograph of the continuous spectrum of the sun, and it showed no trace of lines of rings through Mr. Rutherford's grating. The structure of the corona was well observed by him, but no trace of an exterior ring was seen, and the corona vanished instantly, while in 1871 it remained for several minutes after totality. Only one faint protruberance was observed by Mr. Lockyer. He is greatly surprised at the difference of eclipses occurring in different sun spot periods, and at the intimate relation of the brightness of the corona to sun spots.

At Dallas, Texas, observations of the solar eclipse were generally successful. The clouds interfered somewhat with all observations until near the time of the last contact. The following observations are furnished by Prof. D. P. Todd, of Washington: First external contact at 4 hours 33 minutes 6.5 seconds; second internal contact, 5 hours 38 minutes 33.3 seconds; third internal contact, 5 hours 40 minutes, 57.9 seconds; fourth external contact, 6 hours 40 minutes 25.6 seconds. The record is in Washington mean time. Professor Todd made a careful search for the supposed intra-Mercurial planet with a four inch telescope—none was seen. The clouds were so dense that no objects whatever were seen near the sun. The corona was very brilliant. Several drawings were secured and photographs taken. Prof. Todd was well satisfied with the results of his observations.

At Fort Worth, Tex., for several days beforehand a party of astronomers was located taking preliminary observations for the great eclipse. The party consisted of Leonard Waldo, of Cambridge observatory, general director of the expedition and specially in charge of its photographic work: R. W. Wilson, of Harvard, who noted times of contact and made extensive physical observations: Prof. John K. Rees, of Washington University, St. Louis; W. H. Pulsifer, of St. Louis, and F. E. Seegrave, of Providence R. I., whose labors were in the main directed to the doubtful points, as the corona and its spectrum. The party were magnificently fitted out with telescopes, spectroscopic and polariscopic apparatus, and had with them a skillful photographer from Dallas. Time observations were taken with great care, and every thing got in readiness for the day's work. Day broke

threatening and cloudy, but cleared up at 3 o'clock and stayed clear till all was over. All four contacts were successfully observed. The first contact occurred at eleven mimutes after 3 and the last contact at nineteen minutes after 5, local mean time. The duration of totality was 2 minutes and 30 seconds. The corona was seen in its lower layers entirely surrounding the sun and extending in two great flashes or tufts of auroral light from the east and west limbs. Wilson observed three large prominences, not pink or red, but of a mother-of-pearl tint, and of vast magnitude. The contacts were observed with the spectroscope, and seen sharply at that. Mr. Pulsifer witnessed the reversal of the Fraunhofer lines, and Seegrave saw line 1,474 and measured its thickness. Five photographs of unmistakable excellence were secured, and it is believed those taken with the polariscope will settle some important points as to the constitution of the corona. The spectroscopic observations confirmed those of Young and Harkness as to the continuous spectrum of the corona. Observations as to limit of shadow and duration of totality were taken by assistant observers at McKinney, Dallas and Bresmond. The whole expedition is considered an entire success in point of observations, pictures and sketches.

We are indebted to Prof. Lewis Swift, of Rochester, New York, one of the most distinguished astronomers in the country, who was with the Chicago *Tribune* party to visit the line of totality in the eclipse of Monday, for the following personal information in regard to that most remarkable phenomenon : The eclipse in many respects was not equal to that of 1869, owing to the fact that there was almost a total absence of protuberances. But as far as the corona was concerned it surpassed all modern eclipses. Some idea may be formed of the immense length of the coronal streamers, when told that the sun's diameter is equal to 850,000 miles and the length of the pencils of light that go to form the corona must, if they extend that distance, be each equal in length to 850,000 miles. The party sent out to Denver by the Chicago *Tribune*, consisting of Profs. Colbert, Hough and Swift, of Rochester, N. Y,, inaugurated a class whose special duty it was to draw the corona as it appeared to the naked eye. Over one dozen were drawn, and some drew them to the unheard-of length of over three times the sun's diameter, or equal to 2,550,000 miles. Prof. Watson claims to have discovered Vulcan, and Prof. Swift also saw the same object, but he makes the distance (by estimation) one half a degree greater and its brightness half a magnitude less. There can be but little doubt but that this hypothetical world has at length been found, thanks to the total eclipse and the zeal of our American astronomers. Two protuberances were seen, and those only near the end of totality. They were of the usual pink color, but very unique in shape, one resembling a hook, which must have projected 50,000 miles from the sun, and the other resembled the antlers of a deer. Bailey's Beads were distinctly seen and also the chromosphere, at that part of the sun which the moon uncovered three or four seconds before the end of totality. It is a layer of red-hot hydrogen, some two thousand miles in thickness, extending over the entire surface of the sun. It is from this layer that the protuberances are formed, which the spectroscope decides to be incandescent hydrogen.

ECLIPSES IN THE PRE-CHRISTIAN PERIOD.

When the world was younger than it is now by many centuries, the eclipse of the sun, which will to-morrow be studied with the closest attention by men of science, and watched with an eager and intelligent curiosity by every one wherever it is visible, would have caused the greatest terror even in the most brilliant and highly civilized nations of the time. The lively Greeks and the unimaginative Chinese alike looked upon an eclipse of the sun or moon with awe-struck eyes. They believed it to be beyond the circle of the regular order of nature, a portent big with the presages of calamity and disaster impending over whole empires, republics and peoples Milton expressed this idea as prevalent among the ancients in the splendid imagery in which Satan is described in the Paradise Lost. The poet paints the form of the arch-fiend as one that had not yet lost "all its original brightness," and compares him to the light of day darkened:

As when the sun, new risen,
Looks through the horizontal misty air,
Shorn of his beams, or from behind the moon
In dim eclipse disastrous twilight sheds
On half the nations, and with fear of change
Perplexes Monarchs.

The dread and the awe it inspired were almost universal, and strangely enough their impressions were extraordinarily vivid among the Greeks They were felt by a nation that had given birth to a Homer, an Æschylus, and a Sophocles, and whose greatest historian is unexcelled even to this day. They influenced the leaders of the people as well as the masses even in the days when Socrates was teaching in the streets of Athens, and when a Plato and an Aristotle were writing their immortal works. The Athenians had shaken themselves free from many delusions, but the old mystic astrology they had acquired from the Egyptians and Chaldeans clung to them in this and many analogous forms long after they had learned to laugh at many of the tales of their gods. The singularity of the firm foundation of this belief in a people so acute and so subtle is yet heightened by the assertion, which found credit almost everywhere, that Thales, the famous Ionian philosopher, had predicted the great eclipse of the year 610 B. C. The Medians and the Lydians were then at war, and a fierce engagement was in progress when the shadow of the moon began to obscure the face of the sun. At first it was scarcely noticed, but long before the totality of the eclipse was reached both the armies, infuriated though they were by all the enmity of protracted hostilities were so thoroughly frightened that they laid down their arms, and when the sun again grew bright, to turn away the anger of heaven, peace was at once concluded and a marriage celebrated between the son and the daughter of the rival monarchs. Thales some years afterwards died, but his fame survived him, and yet in spite of this the Athenian superstition was the cause of innumerable woes from another eclipse. It was in the year 413 before our era, when their generals had determined to abandon the siege of Syracuse. The night they had

selected for sailing away from the ill-fated spot chanced to be a full moon, and when its beams shone the brightest over the city and the waters a lunar eclipse suddenly darkened all. The utmost consternation pervaded the whole camp, and the retreat, which would have saved them, was given up. In the morning Nicias consulted the soothsayers, and they unanimously declared that it was the will of heaven that the army should not move or attempt any new enterprise for thrice nine days. Nicias obeyed and lost army and fleet, and the eclipse thus prepared the grave of the Athenian hopes. Eighty-two years afterwards another eclipse threatened to arrest the career of one of the greatest soldiers the world has ever produced. The battle of the Issus had been fought, and Alexander in his triumphant march had forded the Tigris in pursuit of the main body of the army of Darius, and the moon, again at the full, was eclipsed in the sight of the wondering and awe-stricken Macedonians. The officers and the soldiers alike murmured against what they called the insolence of Alexander in opposing the will of heaven, thus manifested by the marvelous sign in the skies. They vowed that they would no longer tempt the gods by penetrating fatrher into an unknown and mysterious country. But Alexander was more cunning and made of sterner stuff than Nicias. He summoned his own astrologer and some Egyptian soothsayers he had with him, and induced them to declare that the sun represented Greece and Macedon, and the moon the Persians, and therefore the obscured disk heralded the defeat of Darius. They were believed, and by thus working upon their credulous belief in the augury he was enabled to pursue his victorious march.

The belief in the supernatural character of a lunar eclipse lingered indeed long after that of the solar became partially known. Artemis, whom the Latins called Diana, was the sister of Apollo, and as he was the god of the sun, her abode and her worship naturally enough came to be associated with that of the moon. Some of the Greeks, with lighter and airier fancies, imagined, therefore, that when her orb was darkened the goddess was absent in the mountains of Caria on a visit to Endymion, with whom she was chastely enamored. Others, whose minds were darker, thought that she had been temporarily dragged from her throne by the incantations of the magicians of Thessaly, the abode, in the opinion of all antiquity, of every species of unholy magic. This latter superstition was held by the Romans, and as soon as the outer rim began to be obscured they ran into the streets, and with the braying of brass trumpets, the clash of iron and the loud cries of women, they endeavored to drown the foul mutterings and the songs of the enchanters and so prevent their reaching or staying in the ears of Diana too long. Some, indeed, believed that if she stayed in Thessaly too long she would never return, and thus night would be forever deprived of its brightest luminary. Juvenal alludes to this tenet of the popular faith when, after sarcastically describing a blue-stocking and strong-minded woman of his day, he says that she made noise enough in her arguments, harangues and commentaries upon the poets, to aid the moon in her troubles without assistance from any one else. This idea of averting the consequences of an eclipse by a noise might well serve Sir

John Lubbock and other scholars as an additional argument for the common origin of all nations. It was entertained not only by the Greeks and Romans, but also by the Chinese. Their theory was that a huge winged dragon caused the darkness by attacking and attempting to devour the sun, and whole villages turned out to beat the gongs and make a horrible din with the clang of their voices and the clash of all the instruments they could procure, and thus drive the dragon off. When the fairest regions of the earth became Christendom, all these foolish fancies of the old world faded away. Something akin to them lingered long in the remoter villages of Europe, and even now the unwonted veil cast over the face of the sun in the height of its splendor, often floods the mind of the imaginative with a not unworthy reverential awe. But now we are all more or less conversant with the real character and causes of an eclipse, and to wait with eager attention for the enlargement of the realms of knowledge by the very change in the heavens that struck terror into the souls of the intellectual Greeks, is not the least among the numerous proofs of the great and manifold gains which time has harvested in its progress from the old, pre-Christian days to this newer and enlightened epoch. —*Globe Democrat.*

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, June 20, 1878.

Has nature always appeared to man under the colors that we know her? Has man always seen the heavens, the trees, the sea, colored with the same tints as we perceive them? In the great theatre of the world, where the decoration and lighting change almost at each hour, has man ever been sensible to the same purple rays of dawn and sun-set, or the tender green of young vegetation? Certainly he has not. The infant is a parallel in point; with it the retina is developed very slowly, and from the centre to the circumference; it is caught by striking colors, but remains perfectly indifferent to vague and undecided shades. Prof. Magnus of Breslau, has just published a work, where he demonstrates that the idea of blue and green has not always been the same during the diverse periods of humanity; that the sense of colors has undergone a transformation, and consequently, the anatomical structure of the eye has changed. Indeed the Professor admits, that at a certain epoch, man felt light, without being able to distinguish the colors; the whole of the retina was then, what its circumference is now, insensible to color, or, where all colors lose their distinction and become confused in a grey, more or less clear. The eye is a *chef-d'œuvre* of nature, the most curious marvel to be perhaps encountered on earth, and hence its capital importance in all matters affecting organic evolution. Light is the excitation produced on organized matter by the mechanical vibrations of ether. The eye has been sensible to the

quantity, before being affected by the quantity of light, that is to say, the power of distinguishing colors. All animated matter, whether animal or vegetable, is sensible to the varied intensity of light. The petioles and leaflets of the sensitive plant become flaccid, when placed in lanterns of violet, blue, or green glass; they become stiff, when changed to a lantern of yellow or red glass. In the case of those microscopic animals, the daphnia, peculiar to ponds, Paul Bert enclosed a number of them in cracked vase. So long as they were left in the dark, the animals swam about indifferently, but the moment a spectral light passed through the crack, the animalcules rushed to the spot; now if the light consisted only of a single colored ray, the daphnia crowded in greatest numbers, as the rays are yellow and red, rather than blue and violet. By what physiological process does the human eye feel not only the quantity, but the quality of light, that is to say, distinguish colors? By the force, more or less strong, with which the ethereal waves shake the sensitive elements of the retina. Such is the cause, altogether mechanical, of the sense of colors. The red and yellow rays, are more perceptible than blue or violet, because they possess more energy and strength, when as ether-waves they strike the middle of the retina, leaving a profounder trace.

Dr. Tholozan, physician to the Shah of Persia, read a paper before the Academy of Science on diphtheria. He stated there is no name either in Persian or Arabic for this disease, and it is not known in Oriental history. It first made its appearance in the centre of Persia, in 1869, spontaneously; it has since attacked individuals in different parts of Persia, other than sea-ports, thus proving the malady has not been imported. Its effects are most disastrous in cold weather.

Paris has a new hospital at Menilmontant, containing 560 beds, each bed having 55 cubic yards of air. The four wings, containing the wards, are wide apart, and five stories high; the fifth story is a spare ward, into which the patients of different wards are conveyed to admit of that vacated being fumigated and cleansed periodically; there are lifts for all the stories, and large fire-places in each ward. Apart from the value of an open chimney as an agent of ventilation, the French surgeons find that a blazing fire produces a most salutary effect on the invalids, especially those capable to sit around it and chat. In addition, the *salles* are warmed by hot air. The wing devoted to *accouchements* has a distinct and separated room for each woman, following Dr. Tarnier's plan. The new hospital is the first in Paris, and far superior to that costly failure—the Hotel Dieu.

Not the least of the wonders connected with the Exhibition, is the building itself; in the 1867 palace, owing to its demi-circumference form, the iron employed could only be afterwards sold as old metal. In the present structure the pieces can be sold without any loss; indeed the building might be taken down and re-erected in any city in the world. The subsoil of the Exhibition is a marvel; it consists of a series of double passages—containing 5,000 pillars some ten feet high—for the purposes of ventilation, gas and water pipes, etc. It is a city of tombs—catacombs under another form. At every twenty yards are ladders, pick axes, etc., so that in case of fire, a guardian has only to raise a trap-door in the floor,

turn a cock, and help himself to all the appliances of the fire brigade. It is in these pillars that the water from the roof of the building is conveyed into the central sewers. The air entering under the grand vestibule is cooled in its circulation along the catacombs, out of which it escapes through the interstices of the flooring, being sucked up by the vane arrangement of the roof; but as the latter is lined with sheeting to blind out the sun, the ventilation of the Champ de Mars leaves much to be desired. So far however, the rain has been more general than sunshine.

Another point deserving of notice, is the splendid span-work, in the roofing of the vast machine galleries. Up to the present engineering has produced nothing so bold, combining lightness, width and strength. The cold and severe lines of the iron structure have been happily relieved by the adoption of the old plan of ceramic decoration; the fantastic coloring of the faiences produces a very agreeable effect.

The sea is agitated by three kinds of movements; currents, ground swells, and waves. The second consists of long undulations, which never break into foam, and are produced by the impulsive action of winds blowing at a great distance and developing only an undulatory motion checked by a calm, or an opposite wind. The swell is very inconvenient from the rolling effects it produces on the ship—and unhappily, on the passengers. M. Bertin has resumed his studies on waves—their height, length, and duration. Admiral d' Urville gave the greatest altitude to waves; as much as 108 feet he estimates some off the Azores in 1820; but Arago roundly asserted the measurement was inexact and considered 26 feet the maximum elevation. M. Bertin agrees with Arago, while averring that waves 39 feet high are infrequent, and those of 60 very rare. The length of a wave may vary from 120 to 140 yards—M. Mottez says 450 yards—and their duration from 23 to 28 seconds. Pending squalls in the Bay of Biscay, by the aid of the oscillometer, M. Bertin determined that the duration of the rolling of a vessel is constant for the same ship and for the same state of its cargo, no matter what may be the intensity and the duration of the succession of the waves.

Dr. Rizzoli, an Italian, relates a singular circumstance connected with an infant, who fifteen days after its birth had a tumor on the small of the back, out of which was growing a tuft of hair two inches long. By means of compression, he reduced the tumor in the course of a year, but the tuft of hair, similar in color to that on the head, continued to flourish. The girl is now seven years old, enjoys perfect health, and the tuft of hair, color changed to chestnut, extends to her knees.

Dr. Couyba, of St. Seirade, has had under his care a cabinet maker who suffers from the mania of a desire to kill somebody and the torture resulting from his efforts to not commit murder. The patient is 21 years of age, and when seven years old he was brought to witness an execution; since then his malady. The doctor compelled him to relate his history, and by prescriptions of phosphuret of zinc has completely cured him. The same medicament has been employed by other

practitioners, and with success, to treat melancholy and several forms of hypochondria. From the horror of the *vide* to the horror of space is but a step. Dr. Raggi, of Bologna, has been attending a young artist who threw himself off a roof. It is customary in Italian cities, when a prize or sizarship is to be won for painting, to shut the candidates up in the Academy and then give them the subject for competition. The young artist in question had nearly completed his remarkable picture, when, seized with the horror of being confined, he dropped from a window to a roof, and jumped thence into the street.

M. Saudry, Professor of Palæontology, has discovered an enormous fossil animal, belonging neither to the crocodile nor exactly to the plesiosaurus families. He names the animal "Eurysaurus," on account of largeness of its head. The remains were found in the lower oölithic formation near Veroul. The enormous reptile had large conical teeth protruding outside the head.

M. Toussaint, has expounded before the Academy of Science, a study on the process of rumination. He states that it is not a ball of the half masticated food which returns to the mouth, but a mouthful of liquid holding the aliments in suspension, the ascension being due to the vise relatively existing in the thoracic space.

Dr. Dunant deplores the social phenomena which tends more and more to attract the rural population to live in cities, a fact lamentably prominent in, but not peculiar to France. Charles V. wrote to Francois I., in the sixteenth century, when this movement or immigration first manifested itself: "Forget not this truth, my brother, the capital where the necessitous classes dominate by number, will infallibly become the tomb of royalties and of great nations." Dr. Dunant proves that the increase in the population of the cities of France coincides with the decrease of inhabitants in the rural districts. It is estimated that the rural element in the urban population is about four-fifths; the population of Paris is two millions, not more than one-fourth of this number are to the manor born, and were it not for this annual steady flux of country people to the capital, citizens would physically die out. In the three most populated departments of the country, in order to obtain 1,000 sound conscripts, 1,790 men must be examined; while in three departments the least peopled, 2,270 have to be examined. The cities where immigration is most marked are weakest in birth rates, but the few marriages that take place are characterized by superior fecundity, The sum total of vice in all cities is nearly equal; it differs chiefly in form. The rurals that come to reside in cities suffer more from diseases than natives, because exposed to less pure air and less healthy food.

M. Baranger has practiced medicine for many years in Russia. In the humblest household is to be found a bath for children, made from a portion of a poplar tree, scooped, and babies are accustomed to a cold bath from their earliest age. The doctor's work is addressed, not so much to young mothers, as to young practition-

ers. For the new-born child three conditions are necessary: pure air, mild and equable temperature. To wet nurses, he counsels that they be fed as much as possible, following, while varying, the regimen to which they have been accustomed, avoiding a too succulent fare, which speedily fattens nurses while diminishing their supply of milk.

If the great movements of the atmosphere were known to us, that is, if we could discover the laws of their formation and direction, meteorology would become a science as exact as chemistry. M. Tissandier, the noted aëronaut, contributes some interesting meteorological facts. The clouds are suspended in the atmosphere in layers or fields, of thickness varying from 220 yards, and at heights from 1,7000 to 4,000 yards. The atmosphere is frequently separated into two distinct portions by strata of clouds, the upper portion may be quite pure, while the lower engenders rain or hail. The pure, upper regions, hold often in suspension spangles of ice, which shine like needles in the sun's rays; there are thus not only ice clouds but layers of crystalline snow. The clouds near the surface of the soil are not only variable, but their aspect changes following the latitude of a country. In the upper regions of the air, the watery vapor rarely moistens the skin: the contrary is the case with fogs at the surface of the soil, but which are only a special form of vapor. There are layers of clouds that are transparent vertically, but not so when viewed horizontally. F. C.

COLORADO NOTES.

Prof. C. E. Robins, writing from Summit, Colorado, July 20, alludes to the REVIEW very complimentarily, and says: "I read with much interest and high approval, the article on National Defense and Military Education, by my old friend, Captain Trowbridge. It is every way admirable. I must, however, take leave to differ wholly from Prof. Mudge—fourth paragraph on page 174, same number of the REVIEW—since both insects and butterflies abound at 12,500 feet in this district to-day. Honey and mason bees, I think, are here; "bumble bees" (*Bombus*) I know are, having only last week come into personal contact with the business end of one. Six of the nine subsections of the class Insecta are represented here, and I am by no means sure that *Coleoptera*, *Neuroptera* and *Myriopoda* are absent. I only have not noticed them. *Lepidoptera* is well represented. *Pieris oleracea* and *Colias philodice* have been seen since the 28th of June. *Bombus* was first observed on the 25th.

The weather is perfect here, 72° being the highest temperature, so far, of the month. I counted yesterday twenty-one snow fields in sight on South Mountain (one 12 feet deep), and thirty-one on North Mountain (Summit Peak).

I have arranged two parties of observation of the solar eclipse on the 29th, one for top of South Mountain, the other, under my personal direction, will take the situation from the triangulation monument on Summit Peak. Have full instructions from Gen. Myers, and if the afternoon is fair expect an interesting time.

COMMERCIAL VALUES OF FOREIGN COINS.

TREASURY DEPARTMENT, OFFICE OF THE DIRECTOR OF THE MINT.
WASHINGTON, D. C., July 22, 1878.

COL. T. S. CASE:

SIR: I have received your letter of the 19th instant, enclosing newspaper slips, relative to the value of the Mexican silver dollar, and requesting information as to the correctness of the statements.

The St. Louis *Times* states that the value of the Mexican dollar was fixed by the Government, Jan. 1, 1878, at 99.8 cents, and is received by the Government at that rate. The Mexican dollar is not receivable by the Government. Section 3584, Revised Statutes, declares that "No foreign gold or silver coins shall be a legal tender in payment of debts." Treasury Circular No. 1, a copy of which is herewith transmitted, fixes the value of the Mexican silver dollar at 99.8 cents as compared with the U. S. Trade dollar.

The valuations given in this circular have no reference whatever to the value of the coins for circulation, but are for the purpose of changing into our money terms for custom purposes, invoices of foreign merchandise, that may be made out in their respective currencies.

Mexican dollars, having no legal tender in the United States, have therefore only a value as bullion, which fluctuates with the price of silver bullion. At current rate, the bullion or intrinsic value of the Mexican dollar, if of full weight and fineness, is about 91 cents, gold, per piece. The full legal weight is 417.-790,536 grains, and the fineness 902.777.

It is the legal tender qualification of the standard silver dollar of 412½ grains, 900 fine, that gives it for circulation its full nominal value, otherwise it would have merely a bullion value, which, at current rate for silver bullion, would be 89.43 cents gold. Very respectfully, H. R. LINDERMAN, *Director.*

Circular exhibiting the values in United States' money of the pure gold or silver representing, respectively, the monetary units and standard coins of foreign countries, in compliance with the act of March 3, 1873.

1878.
Department No. 1.
Secretary's Office.

TREASURY DEPARTMENT,
WASHINGTON, D. C. Jan. 1, 1878.

The first section of the act of March 3, 1873, Statutes at Large, volume 17, page 602, reproduced in Section 3564 of the Revised Statutes provides "that the value of foreign coin, as expressed in the money of account of the United States, shall be that of the pure metal of such coin of standard value," and that "the values of the standard coins in circulation of the various nations of the world shall be estimated annually by the Director of the Mint, and be proclaimed on the first day of January by the Secretary of the Treasury.

The estimate of values contained in the following table has been made by the Director of the Mint, and is hereby proclaimed in compliance with the above-stated provisions of law:

COUNTRY.	MONETARY UNIT.	STANDARD.	VAL. IN U. S. MONEY.	STANDARD COIN.
Austria	Florin	Silver	.45,3	Florin.
Belgium	Franc	Gold and silver	.19,3	5, 10 and 20 francs.
Bolivia	Dollar	Gold and silver	.96,5	Escudo, ½ bolivar, bolivar.
Brazil	Milreis of 1,000 reis	Gold	.54,5	None.
British Possessions in N. Amer.	Dollar	Gold	$1.00	
Bogota	Peso	Gold	.96,5	
Central America	Dollar	Silver	.91,8	Dollar.
Chili	Peso	Gold	.91,2	Condor, doubloon, escudo.
Denmark	Crown	Gold	.26,8	10 and 20 crowns.
Ecuador	Dollar	Silver	.91.8	Dollar.
Egypt	Pound of 100 piasters	Gold	4.97,4	5, 10, 25, 50 piasters.
France	Franc	Gold and silver	.19,3	5, 10, 20 francs,
Great Britain	Pound sterling	Gold	4.86,6½	½ sovereign, sovereign.
Greece	Drachma	Gold and silver	.19,3	5, 10, 20, 50, 100 drachmas.
German Empire	Mark	Gold	.23,8	5, 10, 20 marks.
Japan	Yen	Gold	.99,7	1, 2, 5, 10, 20 yen.
India	Rupee of 16 annas	Silver	.43,6	
Italy	Lira	Gold and silver	.19,3	5, 10, 20, 50, 100 lire.
Liberia	Dollar	Gold	1.00	
Mexico	Dollar	Silver	.99,8	Peso or dollar, 5, 10, 25, 50 centavo.
Netherlands	Florin	Gold and silver	.38,5	Florin; 10 guldens, gold, ($4.01,9.)
Norway	Crown	Gold	.26,8	10 and 20 crowns.
Peru	Dollar	Silver	.91,8	
Portugal	Milreis of 1,000 reis	Gold	1.08	2, 5, 10 milreis.
Russia	Rouble of 100 copecks	Silver	.73,4	¼, ½, 1 rouble.
Sandwich Islands	Dollar	Gold	1.00	
Spain	Peseta of 100 centimes	Gold and silver	.19,3	5, 10, 20, 50, 100 pesetas.
Sweden	Crown	Gold	.26,8	10, 20 crowns,
Switzerland	Franc	Gold and silver	.19,3	5, 10, 20 francs.
Tripoli	Mahbub of 20 piasters	Silver	.82,9	
Tunis	Piaster of 16 caroubs	Silver	.11,8	
Turkey	Piaster	Gold	.04,3	25, 50, 100, 250, 500 piasters
United States of Columbia	Peso	Silver	.91,8	

The above rates will be taken in estimating the values of all foreign merchandise made out in any of said currencies, imported on or after January 1, 1878. I am, very respectfully, JOHN SHERMAN, *Secretary of the Treasury.*

THE INSCRIPTIONS ON MEXICAN DOLLARS.

KANSAS CITY, August 7, 1878.

Editor Western Review of Science and Industry:

SIR:—Having had some communication with Senor Romero Paferio, Superintendent of the republican mint at the city of Mexico, in reference to the inscription upon the obverse of the Mexican dollar, I herewith give you for publication the facts obtained from him. The coinage is almost, if not entirely, confined to the owners and proprietors of the heavy gold and silver mines throughout the several states of the Republic who are empowered and given full authority by the government to coin all bullion by them received into standard coins of the Republic; the law, however, compelling them to stamp all such coins with the value of the coin, place of coinage, date, assayer's name and fineness of metal. In pursuance of this law I give a complete list of the readings and translations of the dollars of 1878, the only additional information necessary being that eight reales equal one peso or dollar, and ten dimes, or twenty granos, are equivalent to nine hundred and three parts of silver to the one thousand

INSCRIPTION AND TRANSLATION.

CITY OF COINAGE.	VALUE.	INITIAL OF CITY	DATE	INITIALS OF ASSAYERS.		LEGAL FINENESS.	
Mexico . . .	*8 R. 8 Reales	M̊. Mexico	1878 "	M. Medina	H. Hermosa	10 D.^{S} 10 dineros	20 G.^{S} 20 granos
Oaxaca . .	*8 R. 8 Reales	O.^{A} Oaxaca	1878 "	A. Augustin	E. Endner	" "	" "
Guanajuato . .	*8 R. 8 Reales	G.^{O} Guanajuato	1878 "	F. Fran'coSardaneta	R. Ramon Mendoza	" "	" "
Zacatecas . .	*8 R. 8 Reales	Z.^{S} Zacatecas	1878 "	J. Jesus	S. Santa Anna	" "	" "
San Luis Potosi	*8 R. 8 Reales	P.^{I} Potosi	1878 "	M. Manuel	H. Herrera	" "	" "
Guadalajara . .	*8 R. 8 Reales	G.^{A} Guadalajara	1878 "	J. Julio	A. Arancivia	" "	" "
Durango . .	*8 R. 8 Reales	D.^{O} Durango	1878 "	P. Pedro	E. Espejo	" "	" "
Chihuahua . .	*8 R. 8 Reales	C.^{A} Chihuahua	1878 "	A. Antonio	V. Valero	" "	" "
Culiacan . . .	*8 R. 8 Reales	C.^{N} Culiacan	1878 "	J. Jorge	D. Douglas	" "	" "
Alamos . . .	*8 R. 8 Reales	A.^{S} Alamos	1878 "	D. Domingo	L. Larraguibel	" "	" "
Hermasillo . .	*8 R. 8 Reales	H.^{O} Hermasillo	1878 "	J. Jesus	A. Acosta	" "	" "

Yours respectfully,

H. P. CHILD.

METEOROLOGY.

A NEW VIEW OF THE WEATHER QUESTION.

BY ISAAC P. NOYES.

(*Continued from the July number.*)

LII. The best portion of the United States for regular conditions to follow each other seems to be east of the Rocky Mountains. It has sometimes been said that our storms come from the Rocky Mountains, but from the weather maps and the natural laws that *low* appears to follow, it would seem that they do not generate anywhere in particular, and are liable to generate at any portion of the Earth's surface; indeed, there is a constant struggle at every point—the strongest force prevails and a small *low* is sometimes, as it were, swallowed up by a larger one and borne on by it, or at times to even develope within a very extended one.

LIII. There are general and local laws, and this accounts for places near each other having currents of wind in even opposite directions, and for the fact while the general wind is in one direction, a local wind may be in another and even just the reverse. In such cases, however, the wind will not generally be very heavy.

LIV. "POLAR WAVES."—This is a nice expression, yet strictly speaking there

is no such thing; the laws that govern the system do not warrant the use of it, at least otherwise than in a figurative sense, for to the north of us there is evidently another line or lines, as it were, of *lows*, running in all directions as generally in the territory of the United States; and to the north of what is here called a "polar wave," there are undoubtedly warmer circles at the time than in the current of this "wave" that is supposed to be, or, as its name implies, is all the way from the icy North, for the reason of there being another center of *low* away up there, whereby in that north latitude local south winds are generated. We learn from Arctic voyagers that the wind up North at times blows from the South, as well as at other places on the Earth's surface; perhaps not as much, yet it does so blow, and this will reasonably account for it and is evidently the reason for it. At the North they might as well have the expression, "an equatorial wave," and it would be just as proper as to say a "polar wave," at least in this sense.

LV. The condition *low* is, as has been remarked, the controlling power—where *low* is there will the wind be concentrated—toward these centers the currents will be established. When (North of the Equator) a North wind blows, it will necessarily be cold, unless, perhaps, as in cases where the *low* is not very positive, and the wind is light and must travel over extended plains, as occasionally in summer, as herein referred to. This, though, is only an illustration of the predominance of the stronger factor. And when a North wind blows it will be on account of a low barometer area at some point South, and not, as is sometimes thought, because of a condition of high barometer up North. A condition of *high* does not push on a current but a condition of *low* pulls along the current; in other words, wind is pulled, not pushed.

LVI. The territory in the United States embraced between that portion of the Rocky Mountains running N. W. and S. E. and S. W. and N. E., Salt Lake City being its eastern angle, and the "Blue mountains" running N. E. and S. W., and the Sierra Nevada mountains to the S. E. and N. W. (see plate B), which has an elevation of from 4,000 to 5,000 feet, seems to have, as it may be termed, a "condition" by itself and to have its own local *lows*, as it were, cut off by the mountains. There are, however, few stations in this locality, so the world is not at present fully informed of its changes; yet, from the observations taken at its four quarters—Salt Lake City, Boise City, Pioche and Humboldt City—the conditions *low* seem to be local. The strip of territory between the mountain range and the coast has quite a different climate from the rest of the United States. California has a peculiar weather condition. If these mountains are the cause of this, it may be asked, why does not the Blue Ridge and the Eastern ranges of mountains affect the Eastern climate? They undoubtedly do, but not in this manner, for *low* seems to travel without much regard to them. They are lower, less extensive (horizontally) and are, as it were, set in the midst of fields, whereby their influence for chilling the air is counterbalanced. On the Pacific slope, however, we have a high and extensive range of mountains that cools the air, thus affording a check to the further development of *low* across them. But for these high and mountainous regions, *low* would undoubtedly

travel directly across the land, start in at the Pacific shore and travel regularly—depending on the force of the heat and neutralizing influences—with more or less rapidity toward the Atlantic coast. But the coast range, backed by the high plateau country as far West as to include the Rocky Mountains, makes quite a different condition of climate for this territory from what it would be if it were comparatively level. To illustrate, say *low* is developed on the land; it is checked in its course eastward by the coldness of the mountain airs and is, as it were, shut off from the East. So, in a similar manner, the *low* that is developed in what may be termed the mountain quadrilateral, but with the territory to the East of the Rocky Mountain range it is altogether different. Here *low* has a broad and comparatively uninterrupted field through which it travels as it wills, or as the Sun will dictate, sometimes starting here and sometimes there. (See plate.)

LVII. The higher the Sun works up, *generally*, the higher the line of *low*, and the reverse; and the more concentrated and positive the *low* will be in these upper or lower latitudes. (Reference is now had to North latitude.) So we see that the North winds prevail in the winter and the South winds in the summer. This a general law and not a special one, that necessarily follows the Sun in its course North and South of the Equator. We do, however, have centers of *low* running quite high during the winter, and this causes South winds and warm weather; when the reverse and *low* is low, we have severe cold winters. Because in the United States or in any parallel of latitude they have a warm winter or cool summer, it does not imply that the weather to the North of this line will be correspondingly affected; it may or may not; may be correspondingly colder or warmer, all depending on the line of *lows* in these regions, which may be quite independent of those to the South of them.

LVIII. As to cold winters and warm winters, it seems a matter of mere accident, so far as we know, yet of course beyond us there may be a Providence in the matter that has special reasons for such a condition of things, but so far as our knowledge reaches it appears to be the merest accident, as the location of *low* itself. *Low* starts at a certain point; it must continually seek new fields; and it is a wise law that it should, even though it may sometimes come around to locations that cause weather that to us appears out of season. This being the case, it seems very plausible to me that it must be irregular in its time and place, and that it is liable to be constantly overlapping itself, so that after a number of years it gets around to certain localities, causing atmospheric conditions that would not seem natural for a given locality, being cold when our months should say warm, and warm when they should say cold. But nature is nature, and it seems in accordance with herself to have her continually, as it were, overtaking herself. She is all the while obeying the strongest force, either positively or negatively. If our seasons in the course of periods change so as not to accord with the present names of the months, it will be in accordance with this principle —and it may account for many changes in the past history of our Earth that cannot otherwise be accounted for. The greater or less amount of water present

has much to do with this matter of climate. We know that there is evidence in past ages of the world, of some northern localities, at least, being much warmer than at present. We also know that eruptions have occurred, and that whole tracts of country have been raised above the surface of the water. As the effect of the sun's rays on the water is peculiar and different from their effect on the land, may there not have been conditions that have made localities relatively different from what they are now. This idea of Nature, as it were, gaining on herself, even though slowly, may also give the color of reason to the idea that the earth is gradually changing—that no one point is permanently relatively fixed with any outside body—and may not the same idea extend to the whole universe? It would not seem unnatural; what may account for a small thing may also account for a large one. All nature works on a similar plan and after the same general laws.

LIX. Low barometer centers in the ocean. The chances are that *low* is distributed over the ocean in a similar manner as on the land. The fact that vessels at sea have the wind from all quarters, meeting with storm centers and calms, and have the wind to shift from one point to another, would evidently, beyond doubt, go to prove that such is the case. This, however, would go to disprove the poetical idea that the waves beating on any given point, say on the rocky shores of New England when the wind in to the eastward, are all the way from the shores of the Eastern continent. It is very improbable that they are ever from such a distance. The chances are that there are a number of low barometer centres between the two continents, and that the wind that raises the seas that strike against the New England shores, starts not more than from two hundred to five hundred miles away, and perhaps not always at as great a distance. The force of the ocean wave is not altogether in the distance that it has to travel, though it does require quite a distance in which to raise a heavy sea; the force of it, however, must depend upon the force of the wind, which in turn depends upon the power of *low*.

LX. Clouds.—In the Signal office at Washington there is a large case in which the weather of the earth is illustrated in miniature. The clouds are formed of cotton and are nicely and artistically executed; the different kinds are true to nature, from the most delicate clouds that are first formed, to the heavy black clouds that produce the heaviest rains. The whole case is a wonder of handiwork, wherein the whole meteorology of the earth may, to the initiated at least, be seen at a glance. It is not the purpose of this article to more than refer to this; it would seem, though, that every college in the land, and every high-school, should have such a model, as by it this subject of the weather can be studied with great advantage. Certain conventional names have been given to the different kinds of clouds. Of course there are all kinds, from the very light to the very heavy, and these can be seen merging into one another without any respect as to the name they bear. However, it is well to know them by the established names, for thereby we not only have the pleasure of knowing them

better, but we can the better describe them and gather information in regard to the weather by their form and combination, etc.

LXI. WINDS.—The winds are governed by the condition *low*, and therefore the governing condition has been spoken of first; yet the two are inseparable, and are only here apparently separated because language will not allow us to speak of two things at once.

LXII. The force of the wind depends upon the power of *low*.

LXIII. The direction of the wind will generally be toward *low*: it may be deflected by local forces, for the local is ever contending against the general, and the reverse. This has been referred to under the head of *low*. The harder the wind the more direct it will blow toward the center. It has been said that if we will stand with our left hands toward the region of *high*, and our right toward the region of *low*, that the wind will be in our faces; but the weather maps do not seem to warrant this as a general fact, though when there is a very large circle of *low*, and therefore not concentrated, such at times may locally appear to be the case. If there is anything in the idea of the conditions of low as herein spoken of, it would seem natural that the currents of air should generally be in towards the centre *low*. The daily weather maps seem to warrant the assertion and to be in full harmony with it.

LXIV. As to the force of the wind, it all depends upon the rapidity with which it is moving, and the rapidity depends upon the positiveness of the condition known as *low*. It is, however, subject to natural forces in a similar manner to more materialistic things, water for example.

LXV. It will be more or less retarded by friction, and over the sea there will be less friction than over the land and less over level tracts than over uneven and mountainous districts.

LXVI. As the wind will travel in as straight a line as possible, we can oftentimes, by observation as to the direction of the wind, trace the course of *low*, and form an approximate idea as to its probable locality. Occasionally there is an apparent exception as to the course of the wind towards *low;* for example, we sometimes have quite a cold south wind. This, however, will be found to be only local, and that such a south wind is in reality a west wind, with simply a changed direction for a comparatively short distance—changed by some local condition, such as a struggle to develope a sub or local *low*, or occasioned by some natural lay of land, such as the presence of a body of water, a mountain range, etc. An illustration of this effect may often be noticed in a city; though the wind may be blowing from the northwest, it may eddy or be deflected around some corner and blow (locally) from the southwest or even south. Because in this confined locality the wind was from the south, it would not be right to say that it was a south wind.

LXVII. Old people often speak of the wind going around from one quarter to another "with the sun." Such observations are oftentimes made and transmitted from generation to generation, yet without reason. People see that a storm comes, passes and clears off in a certain manner, but it was not until

within a very few years that we could trace a storm over such a vast area as the United States. Now we see why the wind should come up in a certain manner and pass around to another quarter, and so on till it comes out finally with the wind from another direction, and clears off; and why the wind is ever going from one point of the compass to another, and why a storm is liable to come up with one wind as well as with another.

LXVIII. It is a common thing to hear that "the wind is blowing up a storm." It may seem contrary to the wisdom of the past to deny that the "wind blows up a storm," yet from the remarks on the condition, *low*, it must seem obvious that the wind does not blow up a storm, but rather that, if anything, the reverse of this is more true, that the storm raises the wind. A *low* is developed, the wind rushes in to fill the vacuum. If *low* is, say in the middle of the United States, to the west of the same, the wind will be from the west; while to the east of the condition, the wind will be generally from the east: and if it passes to the south of a certain point, the wind at that point would be from the north, and the reverse if to the north. So the manner in which the vane turns will depend upon the relative location of the center of the condition *low*, toward which the wind will always blow. This can be better traced by reference to the map or plate.

LXIX. Then an east wind is generally considered a very stormy one with us, yet it is purely accidental, and we sometimes have exceedingly pleasant and clear weather with an easterly wind, for the simple reason that *low* is traveling to the west of our particular locality, and may pass us by altogether without producing a storm in our immediate locality. The greater part of the time, however, an east wind is caused by *low* being in the line of our locality, then the clouds that have been generating for days over the Atlantic ocean are brought to us and we have rain in abundance, and all the effects derived from the condition of low barometer. Yet in this connection it must be remembered that what may be a northeast storm in one locality, will to another locality, on some other side of *low* be called a storm from another quarter, i. e., a condition *low* is circular, and the storm converges toward it from every direction. This center may not be an exact circle or even approximate thereto, for oftentimes its real outline is anything but circular. The term circular is here used only in a general sense.

LXX. When there is a very positive *low*, a fierce wind is developed, and as the sun first strikes the east, the storm will travel generally in that direction, and as the wind will be from all directions toward this center, an elastic medium of air is established, as it were, as a cushion for the wind from each quarter to receive and be received upon, whereby the force of tornadoes are checked; otherwise they would do far more damage than they do.

LXXI. Much has been said about equinoctial storms. People have an idea that when the sun "crosses the line," that there must be some extra commotion whereby a great storm is generated. In regard to this, I will venture the assertion that there is no such thing as an "equinoctial storm." Any storm that occurs within two weeks, before or after, is commonly given this name; because

such a storm happens, and is always liable to happen, somewhere about this time, it is no sign that the "equinox" has anything to do with it. Storms are liable to generate at all times, one may occur at this particular time, and that, too, in merely certain localities, when it is perfectly fair at others. This being the case it seems absurd to thus connect it with the sun passing over a certain imaginary line.

LXXII. Rain and snow are essentially the same. This need not be told the initiated, yet there are people who think that the Signal officer has made an error when it is said that "it will probably rain," and it snows instead. It is a mere difference between a few degrees of temperature, and perhaps local temperature at that; if warm it will rain, if cold it will snow.

LXXIII. It is sometimes remarked, that it *feels* like rain or snow, but that it is too cold. In this case the clouds that contain this moisture are present, but if warmer a little beyond, they will pass along to that warmer spot. The strongest force, whether it be heat, cold, or wind, will predominate; the merely local must (generally) give way for the general or extended conditions.

LXXIV. When *low* extends over a large territory, or we are in the center of a concentrated one, the rain will come down straight or nearly so; but when the center of *low* is to one side and a fierce wind is rushing in toward it, carrying heavy clouds along, the rain will come down at an angle; the more fierce the more obtuse the angle at which the rain will fall, and sometimes the wind is so powerful as to make it come down almost horizontal.

LXXV. Trade winds and hurricanes we have not much to do with in this latitude and longitude, yet they, with other conditions, must obey the general law of air seeking an equilibrium. It would seem from what we know of the laws of storms in general, that the "trades" should, as they do, prevail in the latitudes nearest the equator, and that hurricanes should predominate in the same localities.

LXXVI. The manner in which a fierce wind travels has been much commented upon. It is said that it travels, as it were, in epicycles—going comparatively straight or in an elongated curve for quite a distance, then taking a sudden turn in the shape of a small circle, as is sometimes the case with dust in the street. This, however, does not accord with the *general* law, though the air, like the heavier material water, is evidently turned in this manner by local inertia. The more fierce the wind the more compact and the more it is liable to be deflected or swept around in a circle, the same as water, by any resistance that it may meet with. Its inertia of speed forces it on—the inertia of fixed objects, even though small, must cause some compromise—must be overcome.

LXXVII. Tornadoes look black, and oftentimes much resemble a huge serpent rushing over the ground. It would seem to be comparatively easy to account for this. The fiercer the wind the more condensed, and as it moves over the earth at the rate of a hundred miles or so an hour, it will necessarily take up with it much loose earth, dust, etc., whereby darkness of color is given to the whole mass. Then as to its serpentine form, the very compactness will

account for that. The more compact, the more it holds together and becomes a thing of life, having elasticity whereby it may be deflected by one object to such an extent as to pass entirely over or by another object beyond, either horizontally or perpendicularly; thus, up or down, to right or left, it sweeps along on its course, taking as straight a line as possible, yet even in its most fierce condition being obliged to compromise its course more or less, bearing evidence to the law that the strongest force must prevail and showing that some mere local inertia is strong enough to deflect it from the straight line in which it seeks to travel. It is said, sometimes, to rain all sorts of things—sticks, stones, frogs, etc. A tornado, moving at such a fierce rate, is liable to take up and carry along with it any such small things, and when there is a lull in the wind or anything tends to retard it or sufficiently check its velocity, these objects that were taken up will fall to the earth, and in that locality we will have a "shower" of sticks, stones, frogs, etc., although, strictly speaking, the term "shower" will not be appropriate.

LXXVIII. Wind has not much force until it, by great velocity, becomes much compressed and gains, as it were, solidity.

LXXIX. At times the air is very oppressive, in common phraseology, called "muggy." This occurs when *low* is being developed or we are on the outskirts of an extended condition of *low*. The atmosphere is full of moisture displacing air; in addition to this, the air is quite stationary; there is no new supply, or a very little, coming in from other quarters—the allowance of air is small. As soon as precipitation takes place, or *low* becomes concentrated or moves on we get a bountiful supply of air, which, in contrast, is very refreshing.

LXXX. West winds seem to prevail with us, the cause being that *low* is more off in the ocean than on the land. Water heats quicker, the land retains heat the best. This will account for the constant changes, under some circumstances, such as night breezes and day breezes, as occur along the shores of great bodies of water.

LXXXI. Probably the best place for comfort would be between *high* and *low*; here we get a good breeze; we are, as it were, *in the current*, where the ventilation is generally perfect—occasionally there is too much rapidity for some local comfort, but we must reconcile ourselves with this when we know that it is carrying great comfort to another quarter, restoring balance of air or temperature to our fellow men in some other locality.

LXXXII. In the summer, especially the latter part, we have the wind much from what the Indians practically called the "sweet Southwest." This is occasioned by a moderate low barometer up in the Northeast, perhaps off New Foundland's banks, that region of fogs and mists. Had the Indians known the meteorological facts of the present day they would have had reason to have given this sweet name to the northeast rather than to the southwest—to the quarter that drew the currents on, rather than to a quarter from whence they were collected. The "sweet Southwest," however, at least along the Atlantic coast, is a most refreshing wind, bearing with it the tempered conditions of the West and South

and the effects of land and water; it was indeed beautifully and appropriately named by those sons of nature whom we term Indians. At this season of the year these winds are peculiar, in that they rise with the sun and die away with it, conclusively showing that heat is the cause of the wind. Though the wind dies away with the sun it very soon springs up again, and this may seem to controvert the theory, but instead it only substantiates it. The wind springs up but veers to the south or southeast, according to the trend of the coast, this being caused by the better retention of the heat by the land than by the water. During the day it is on the water, up off the northeast coast. The night cools the water, the land retains the heat, so a current is established landward.

LXXXIII. Later in the season, and indeed, earlier too, *low* is for much of the time still off in the ocean, but in a lower latitude, generating a northwest wind, causing fierce storms in the neighborhood of that storm centre off the coast of Hatteras, lying between there and the Bermuda Islands, in the locality by sailors called the "Devil's Corner." Sailors oftentimes have very expressive names for places and things. This is the locality where concentrated and even protracted *lows* are generated, therefore, a locality of storms; hence the name implying a very bad place—one to be avoided, and one where much caution must be exercised when necessity forces one to pass it. Yet this locality is not always deserving of this name; during the winter and spring months it would seem to be the most appropriate.

LXXXIV. Under Low.—We see that low barometer is continually on the march, from point to point, from the land to the sea and from the sea to the land. After a storm has passed to the eastward the wind comes out more or less fiercely from the west; the sky is cleared of clouds; the wind hangs in this quarter for a a day or two, and, though cool at first, finally dies away, and in summer it comes out very hot and dry. These are probably the most trying days in summer, but this condition is not generally of long duration. *Low* is all the while as it were swimming 'round a circle of larger or smaller dimensions. Narragansett Bay in summer is a fine place to watch these changes. They generally occur about an hour or two after mid-day. At such times it is a common sight to see boats at different points sailing down as well as up the bay *before the wind*, though very little wind, and with a space of perhaps a mile or two between where it is all calm, with a slight flow of wind, first one way then another; the north wind and westerly wind receding and the southerly wind gaining, and by and by coming out a good breeze to the southwest. *Low*, in order to make this change, has the while been shifting, and perhaps the governing one in this case is located up in the northeast, just off the ocean.

The partial wreck of the steamer Massachusetts, while on her eastern trip in Long Island Sound, the early part of November, 1877, is a good illustration of the change of wind in a similar manner, yet more sudden. A heavy southeast storm had prevailed during the day. The captain of the steamer, in order to avoid running the risk of exposing his boat to the fierce winds and waves of the Atlantic ocean, had hugged the Long Island shore. It was very foggy weather,

and so thick, as the sailors say, that no lights were seen from the shore. They were running by dead-reckoning, that is, by their knowledge of the speed of the boat, the force of the currents and general experience of navigation in these waters. As the steamer was, about 11 p. m., near the gate to the ocean, it was decided to turn the head around towards the west, and "stand-by" till morning. From want of exact knowledge of their situation, from not having proper data, the boat was accidentally run ashore on a projecting sand point. Had the wind remained to the Southeast, at the slow rate of speed at which the boat was going, this would not have been a serious matter, but soon after midnight, or thereabout, the wind suddenly came out to the Northwest. The captain now found himself, instead of under a lea, on a lea-shore and at the mercy of a fierce wind. What had caused the change? When we follow up the path of *low*, it is all as plain of explanation as the blowing of the wind itself. On the return of another day, the advancing heat of the sun out on the ocean had caused (or pulled) the center of *low* to the eastward, whereby the wind, that had been blowing toward this center from the northward and westward, was permitted to go into other fields, as it were, in order still to seek the point of *low* that it is all the while striving for. These changes are more or less sudden, depending on the power and concentration of *low* and the relation that it bears to a given locality.

LXXXV. In this connection there are a few other general points of illustration that it may be well to refer to. It is known that there is no regularity to the speed and continuance of *low*; it evidently is continually on the move, yet practically for some localities in the United States it is stationary for some two, three, and sometimes four days, and, on rare occasions, perhaps more; but the most severe spell of such a blow that I bear in mind is that which commenced on the first of March, 1872, and continued with unsurpassed fierceness till the fifth. During this time the conditions were evidently favorable for a concentrated and long *low* off the coast along down and by Hatteras, or, in what sailors call the "Devil's Corner." This was probably one of the most fierce and continuous winds that we have had along the Atlantic coast.

LXXXVI. Sometimes we see all, or nearly all, the evidences of a storm; the clouds form, the wind is in the right direction, and it "feels like rain," but no rain comes perhaps for a month, two months, or even more. Everything is parched for want of rain, and dust is very abundant. This has given rise to the saying "that all signs fail in dry times." It would seem that there could be no fault to find with the "signs;" so far as they are concerned they are all right—they are evidence of conditions actually existing, but the trouble is that these conditions are a long way off. *Low* circles around, but sometimes, more particularly in the summer, it goes very far in some one direction, the circles that it describes are very large while its own circle or center is apt to be contracted, so that it passes by some localities merely touching them with its outer edge, which frequently gives the "sign" as it passes, but nothing more; the rain that is developed, even in part, in the dry localities, is taken off to other places.

LXXXVII. Also on such occasions we see the evening flashes of light,

away off in the distant horizon. This, in order possibly to give a name even though the cause was not known, is called "heat-lightning." On the basis of these remarks, and I trust that they are not far out of the way, though we are still in the dark as to many facts, there does not seem as though there could be any such thing as is implied by this name, but rather that it is a *bona fide* lightning from some center of *low*—perhaps a *local low* or some regular passing centre of *low*, some twenty miles or more away.

LXXXVIII. There is also a common expression in regard to thunder, that "Thunder in the morning, sailors take warning; Thunder at night, sailors delight," as though it were a law that it was worse to have thunder in the morning than in the evening, etc. In the first place it depends upon which direction the thunder proceeds from; if to the East of us it is evident that the storm center or *low* has passed our locality; if to the North that it is passing; if to the South, that it is working its way up towards us; and if to the West, that we may expect it to be or come quite near us. Secondly, there may not be any great "delight" in hearing thunder at night, as in the other case, it all depends on the direction from which it comes, immediately about us, to the North, East, South or West of us. Thunder is more apt to occur in the evening on account of the development of the heat of the day (see section XXXVIII on electricity); where there is thunder in the morning it shows great heat and perhaps the development of a low barometer, and therefore indication of a severe storm. These remarks on thunder and lightning may also, in a general way, apply to the lines "a *rainbow* in the morning," etc. The principle is the same.

LXXXIX. Among other common notions in this department of the weather is the idea that at certain times, mostly morning and evening, when a few heavy broken clouds are massed together and the sunlight is shining through such openings as there may be here and there among them, that the sun is drawing water. This notion evidently grew out of the desire to account for a certain natural phenomena after a supposed reasonable manner; but the knowledge of the present will not sustain any such fanciful idea as this implies. In the first place the sun does not "draw" water, at least in the sense we commonly use this word. It *evaporates* the water and combines it with air, and thereby forms clouds. Secondly, this process is going on all the while, at least when there is sufficient heat. Thirdly, this phenomena called the "sun drawing water," is simply the rays of the sun shining through an opening, and we have the same effect whether the opening be in a cloud or in a wall. The denser the cloud immediately under the sun and the clearer the sky elsewhere, the stronger this effect will be.

In this paper it has been the aim of the writer, as may be readily seen, to bring together all the points in relation to the weather that he could think of, and in order to facilitate memory and to draw special attention to these points so that they would not be lost in the mass, he adopted the plan of numbering each item as it presented itself in as much order as possible, that one point might, as near as possible, suggest the other. He does not claim that he has discovered all, or that all his deductions are right. He has simply endeavored to present the subject

from his point of view, and as the same appears to him. And now he stands like others interested in this beautiful study, awaiting further developments. Of course he would like to have future developments sustain what he has here set forth, yet he trusts that he will be enabled to see new facts in an impartial light, and if, perchance, more light should prove him in error as to conclusions, that nevertheless there may be found in this paper some points that may be of interest to those who seek to investigate the mysterious forces that go to make up our weather system. And he further hopes that the interest of the people at large will be general, and of so earnest a nature as to sustain the labors of those who are engaged in the duty of collecting facts pertaining to this branch of science, and extend to them a practical sympathy whereby they may be the better enabled to follow up the great work before them; and further, that this sympathy may so extend that the nations of the earth may enter into fellowship with each other in collecting facts that bear upon this subject; for only by such cosmopolitan measures can we hope to gain important facts from all quarters of the globe, whereby we may become familiar with the weather system or systems of the world. For this purpose we should have facilities to collect facts, not only from the civilized countries and places easy of access, but from such places as at present are quite inaccessible, either from peculiar conditions of people or climate.

PROGNOSTICATIONS.

After reading these *Statements and Comments* the reader may inquire if there is no way for the individual, unaided by instruments, to forecast the weather. There are certain signs which if one will note from time to time whereby they may become quite expert; but then these personal prognostications must necessarily be confined to the local conditions. The individual from his local standpoint cannot tell what the general conditions are; and herein is where the labors of the signal office particularly become of value, and of greater value than it is possible for the prognostications of the local observer to be, even to his own locality, for the general always governs the local, and knowledge of what is and has been, gives more value to the judgment of the future. A single individual standing on the ground cannot command a very wide horizon, and even on the house-top cannot command anything like the extended region of one who is up in a balloon two or three miles above the earth. The single individual, even aided by instruments, can only know of the conditions of his immediate vicinity; while the Signal Office from its daily reports is able to see the conditions of the whole country; it can note the rate, direction and intensity of the storm center, and from these form a very accurate calculation as to the probability of its passing along a certain line, and in influencing the weather at a particular locality; yet, notwithstanding this, almanac makers and others think they have, or pretend to have, some system different from the natural laws of calculation whereby they can tell what the weather will be a year in advance; and, to make their pretensions more absurd, they make no distinction between different localities, when it is a well-known fact, and now easily demonstrated, that two localities quite near each other may have, and often do have, quite different weather—one being hot

while the other is cold, one wet while the other is dry, all depending on the relative situation of *low*.

In the past, before we had the facts of the present, this ridiculous pretension was, perhaps, excusable, for then very little was known of the general weather system—we were all ignorant of the facts that have been ascertained within the past few years. The best that could be done was to judge the weather of one year by that of another, and really the whole matter of attempted prognostication, instead of being a thing of calculation was, and is, really, but a mere matter of guess-work. In these so-called calculations much was figured from the moon, when the moon is a most contemptibly insignificant force in the matter and has about as much to do with the matter as it has with making people mad. Yet, years ago, it was so firmly believed that the moon was the cause of madness that this satellite of the earth gave the name to that unfortunate affliction of humanity. No person now, however, will hold to the absurd idea that lunacy, even though the *name* is connected with the moon, is in any way caused by the moon. As explained elsewhere, the sun is the great physical force that makes our weather system. The better we understand all the forces that go to make up the weather system, make ourselves familiar with all the changes that occur in and constitute the conditions that follow one another, the better weather prophets we will become. We must necessarily keep in mind as much as possible the location of *low*, for on this hangs all the information we seek, remembering that the wind will always be *generally* towards the point of low barometer; by bearing this in mind we can approximate the location of *low* in relation to our locality. Then we must note the extent of cloudiness and familiarize ourselves with the different kinds of clouds, bearing in mind that the heavier the clouds and the more extensive the cloudiness the more apt we are to get rain. If the wind is to the east it shows that the centre of *low* is to our west and is approaching our locality, although the centre of the storm may go either to the north or south of us. The presence of low barometer is indicated by a closeness of the atmosphere, commonly called "muggy." If *low* is to the north of us we will have southerly and generally warm winds, while if to the south of us, it will be (relatively) cold (for the season); and, finally, to bear in mind the generally well-known fact that a storm clears off with a west wind and a clear, or quite clear, sky.

These points, noted and studied, will much enhance the correctness of our individual weather prophecies, though the individual can never, for reasons herein explained, rival the prognostications of the Weather Bureau, or foretell the weather for any length of time ahead; and it is doubtful if the Weather Bureau itself can ever foretell the weather for any great length of time in advance, but if it ever does it will only be after years of careful observations whereby it may discover certain changes (if such a thing exists) that take place at regular periods of time, but these changes are so unlimited and can be of such an endless variety it is very much to be doubted if they can ever be discovered to follow a regular course that may be calculated for any great period ahead. Yet, even though such appears to be a hopeless task, it should not hinder our labors in this direc-

tion nor cause us to neglect to follow up the good work so zealously begun, for we know not what high reward such earnest labors may meet with, and, even though we cannot discover any tangible law by which this is governed, there is still much left to acquire that will greatly repay us for our sacrifice in this behalf. If there be no similarity between certain periods we will still have gained a great point—we will have proved this as a fact and ascertained how this branch of nature works, for at present we are in the dark in this matter; yet, what facts we have tend to prove that the changes are endless and of infinite variety, and it would seem that the best purposes of nature were obtained from this system, for thereby the grateful showers are the most evenly distributed over the earth.

By the inauguration of the present Weather Bureau more knowledge has been gained in this department in a few years than was ever before known. The work of the past, however, is not to be depreciated, because the present has greater facilities. All enlightened people should be interested in these greater facilities, and, so far as they are able, lend a hand in advancing to them a greater degree of perfection. What we want now is coöperation on the part of the gatherers of scientific information the world over and then a combined and universal weather corps with facilities for extending its simultaneous labors over all important sections of the world, on sea as well as on land. It cannot be expected that so great a work as this would be accomplished in a few months, or even in a number of years, yet steps may be taken towards its accomplishment, and year by year we can advance our stations to new grounds and form combinations and awaken sympathy and zeal on the part of those who at present are ignorant or indifferent as to scientific matters. Only by such extended and united efforts can we fully understand the complete weather system of our planet, and it is to be hoped that the controlling spirits of the world will have sufficient interest and sympathy in the matter to arouse their zeal on behalf of so worthy a cause.

ISAAC P. NOYES.

WASHINGTON, D. C., April, 1878.

ON CLIMATIC CHANGES IN THE PRAIRIE REGION OF THE UNITED STATES.

THE EFFECT OF DISBOSCATION ON CLIMATE, AND THE RELATION OF FOREST GROWTH TO ATMOSPHERIC PHENOMENA.

BY COLONEL HENRY INMAN, OF KANSAS.

[*Continued from July Number.*]

It appears, however, to be unquestionably true, that the destruction of forests has within strictly historic times, wrought desolation in regions where the soil is inherently fertile and which once bloomed with all the splendor of a garden; districts that once were the scene of a busy population, and where mighty cities provoked the admiration of the civilized world, but which are now only howling

wildernesses through the agency of man; devastated by his own folly or his ignorance of nature's rigorous laws.

It is also unquestionably true, that a restoration, by the agency of man, to those regions their previous physical condition by the cultivation of forests, would re-establish their once boasted fertility.

The inquiry then is, if the destruction of forests would bring about the meteorological effects in certain districts—as will presently be shown—and their restoration reinstate the primitive conditions, whether a region primarily destitute of trees in consequence of climatic causes, with a soil as inherently fertile as any where on earth, but by deficiency of aqueous precipitation insusceptible to a fully developed system of agriculture, can be made by the artificial creation of forests to reach a state that will meet the complete requirements of our progressive civilization, agriculturally considered?

Reference will now be made to the most authentic statistics on the subject of the effect of disrobing a country of forests, after which will be shown what progress has been made in the cultivation of timber on the Great Plains, the possibilities in that direction, and how trees affect climate.

Mr. George P. Marsh, in his grand work* showing man's power over nature, and the influence he has exerted on the physical condition of the earth, says:

"If we compare the present physical condition of the countries [around the borders of the Mediterranean] with the description that ancient geographers and historians have given of their fertility and general capability of ministering to human uses, we shall find that more than half of their whole extent * * is either deserted by civilized men and surrendered to hopeless desolation, or at least greatly reduced both in productiveness and population. Vast forests have disappeared from mountain spurs and ridges; the vegetable earth, accumulated beneath the trees by the decay of leaves and fallen trunks, the soil of Alpine pastures which skirted and indented the woods, and the mould of the upland fields, are washed away; meadows once fertilized by irrigation are waste and unproductive because the cisterns and reservoirs that supplied the ancient canals are broken, or the springs that fed them dried up; rivers famous in history and in song have shrunk to humble brooklets; the willows that ornamented and protected the banks of the lesser water-courses are gone, and the rivers have ceased to exist as perennial currents, because the little water that finds its way into their old channels is evaporated by the droughts of summer, or absorbed by the parched earth before it reaches the lowlands; the beds of the brooks have widened into broad expanses of pebbles and gravel, over which, though in the hot season passed dryshod, in winter sea-like torrents thunder; the entrances of navigable streams are obstructed by sand-bars; and harbors, once marts of an extensive commerce, are shoaled by the deposits of the rivers at whose mouths they lie."

Spain was once famed for its fertility. In those days the forest covered immense areas; the hills and the valleys were dotted with emerald tinted groves,

*Man and Nature.

which to the Moors were as sacred as the oak to the Druids, and they were preserved with an almost religious zeal; but how different is Spain to-day?

Hardly a hundred years had elapsed after the expulsion of the Moors, before the Spaniards had stripped whole districts of their timber, and there followed deterioration of soil and aridity of climate to such a degree, that it may be considered one of the most important factors in the decay of her industries. Sir John F. W. Herschel in his work on physical geography, in discoursing upon the absence of trees in relation to the rain-fall, gives it this endorsement: "the destruction of the forests is no doubt one of the reasons of the extreme aridity of the interior of Spain. The hatred of a Spaniard toward a tree is proverbial."

In 1789, the valleys of the Rhone and the Gironde and the whole region of southern and southeastern France, the slopes of the Alps and the Pyrenees were perfect pictures of fertility. Immense herds of cattle and sheep were reveling in the rich mountain pastures, and the beautiful valleys that nestled between the lofty ranges were as fruitful as a summer garden. The soil was rich in all the elements of productiveness, and the climate as delicious as under the Italian skies.

At that time the vast forest of Cévennes bordered the Rhone, and the mountain slopes were densely covered with a growth of giant timber, all of which have gradually disappeared under the ruthless axe of the woodman, bringing with the work of devastation climatic results that have completely changed the scene of beauty into one of desolation.

The whole region now is visited by intense drouths, deluging storms, and fearful cold in turns. Torrents of maddened water have plowed through the once purple vineyards, and huge masses of rock, extensive reaches of sand and beds of gravel have filled up those once charming valleys and converted them into irredeemable wastes.

These changes of climate in France, due to the disboscation of the forests, have been so marked that the government revenues from the districts referred to have been reduced to almost nothing in comparison to what they were a century ago. Hon. G. P. Marsh* again, in referring to this same subject, says:

"There are parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, where the operation of causes set in action by man has brought the face of the earth to a desolation almost as complete as that of the moon; and though, within that brief space of time men call the "historical period," they are known to have been covered with luxuriant woods, verdant pastures and fertile meadows, they are now too far deteriorated to be reclaimed by man; nor can they become again fitted for human use except through great geologic changes or other mysterious influences or agencies of which we have no present knowledge, and over which we have no prospective control."

The author of "Economie Rurale" furnishes an account "of the subsidence and subsequent increase of the waters of Lake Valencia in the valley of Aragua. Prior to the visit of Humboldt in 1800, the volume of water had been diminishing for half a century, exposing from time to time the surface of numerous islands

* Man and Nature, 1864,

entirely covered by water at an earlier period. The distinguished traveler made the phenomena a subject of careful examination, proved the unsoundness of the usually received hypothesis of a subterranean outlet, and did not hesitate to explain the gradual depression of the level of the lake as the result of the numerous clearings made in the valley during the latter half of the preceding century.

"In 1822 Boussingault visited the locality and found that instead of retiring, the waters of the lake had been sensibly rising for several years. A number of sugar and cotton plantations on land formerly constituting a part of its bed had become submerged, and the islands above the surface at the time of Humboldt's visit had disappeared. No apparent reason existed for this, as no particular change in the seasons had been noticed. Boussingault proceeds to state that during the war for independence by the South American colonies, the fertile valley of Aragua became the theater of bloody struggles, desolating its fields and exterminating its population. The large plantations, which during the preceding fifty years had been wrested from the domain of the forests were abandoned, and in the tropical climate of Venezuela the ten or a dozen years that had elapsed had been sufficient to cover them a second time with trees and shade; the rise of the water of the lake keeping pace with the encroachment of the forest. Other instances are mentioned by the same writer of large clearings in Venezuela and New Grenada being accompanied by a similar disappearance of the waters of adjacent lakes, while in districts always bare of trees, or where the forest had never been disturbed, no such changes had occurred. This eminent scholar maintained that the lakes of Switzerland have sustained a like depression of level since the too prevalent destruction of woods and arrives at the general conclusion that 'in countries where great clearings have been made there has most probably been a diminution of the living waters which flow upon the surface of the ground, and that very restricted local clearings may diminish and even suppress springs and brooks without any reduction in the total quantity of the rain.'

Marchand relates the circumstance of the Lorne and the Doubs, streams in Switzerland, from time immemorial furnishing an abundant water power for the manufacturing establishments on their banks, becoming so deficient in the supply of water after cutting the woods near their sources, as no longer to furnish the required power, so that in one case steam had to be introduced and in the other the factory was stopped entirely.

Hummel mentions a striking instance of the influence of forests on the flow of springs, as witnessed at Heilbroun. The woods on the hills surrounding the town are treated, it appears, as a copse, being used only for supplying fuel. They are cut at intervals of twenty or thirty years, and planted or allowed to shoot up again from the roots. Regularly after each cutting the springs of Heilbroun fail. But as the young shoots increase in size, the water flows more freely, and at length bubbles up again in all its original abundance until the next cutting takes place.

But the conservative influence of trees is not confined to mountainous and warm countries. The climate of the Schelde Valley and the plains of Bavaria and of Austria was so much injured by immoderate clearings, in the judgment of

those having the best opportunities of deciding correctly, that extensive areas have been replanted, with favorable effects, it is said, anticipated by the projectors of the enterprise."

The Imperial Academy of Vienna in 1073, appointed a special committee composed of distinguished savans, members of the constitution, to discuss and report upon a memoir presented previously by Mr. Hofruther Wex "upon the diminution of the water of rivers and streams." These sessions were held by the committee and the memoir of Mr. Wex exhaustively argued. An immense mass of statistics were presented and the report of the commission, elaborate in details, sums up its opinions as follows, for which only we have room: "The fact of the diminution of water in streams, which diminution is connected with the copiousness of springs which supply them, being admitted, the commission find the causes of this phenomenon: 1st. In the continued cutting down of the woods whose salutary influence in the raising of the hygrometer, the amelioration of external temperature, the decrease of evaporation, and the promotion of a regular escape of the precipitation is evident. 2d. In the desiccation of the lakes, ponds and bogs, which likewise raises the hygrometic conditions, decreases evaporation, moderates extreme temperatures, and lastly, through the fissures in the soil, directly promotes the formation of springs." * * *

It has been abundantly shown in the foregoing references, that the desiccation of lakes and bogs, which the Vienna Academy, in the report of its commission, assigns for the second cause for the "diminution of water in rivers and springs," is directly attributable to the extinguishment of the forest; consequently the causes which the commission finds, to account for the phenomena under their consideration, may be stated fully in their first conclusion. In other words, the conditions for which they were to assign a cause, is found in the disboscation of the timber of the affected region.

The devastating and disastrous climatic results of disrobing a country of its wealth of timber, have been so incontestibly proved by the distinguished authorities quoted, that it leaves very little room to doubt the correctness of the conclusions arrived at, and they are consequently divested of any hypothetical aspect.

In order fully to comprehend the relations of forests to climate, it is necessary to devote a little space to the nature of vegetation, and the process by which vegetable life is sustained.

Nearly all the inorganic matter essential to the perfect development of plant life is extracted by the secret operations of nature from the soil surrounding their roots, while the sugar, acids and starch are derived from the air.

The rainfall is the agent by which inorganic substances are so disposed that the roots are enabled to select and assimilate that portion which is essential to the life of the plant.

Carbonic acid, a substance as necessary to the support of vegetation as atmospheric air to animal life, is constantly absorbed by day, by the leaves of plants, the carbon of which is separated by them and metamorphosed into woody fibre; the oxygen, the other element of the compound, being rejected, is

returned to the atmosphere. Ammonia, another important constituent in the life of a plant, results from the decay of animal matter, and is taken up by the atmosphere, from whence it is returned to the soil in the rain and snow, it is then absorbed by the earth and taken up by the plant, which separates it into its elements, one moiety of which enters into the formation of the wood and the other into the gluten.

Humus, or black mould, the evidence of fertility in soils, is decayed vegetable matter; when the earth is plowed up the underlying humus is brought in contact with the air and a fresh supply of carbonic acid is supplied. Humus is the source of vegetable production in every soil, and the impoverishment of land is principally owing to the removal of the annual product without the return of an equivalent. Where the vegetable matter is allowed to decay on the soil, its richness is constantly increased, and the result, for long periods, is the mighty fertility of the virgin lands of the great West.

There is hardly any portion of the great Plains where the soil is not sufficiently rich to meet all the requirements of vegetable life in a remarkable degree; the accumulation of humus by the early decay of the luxuriant grasses that have carpeted them for centuries has given them a soil of the highest agricultural possibilities.

Lime, in some of its combinations, constitutes as an essential engredient in all the more valuable cereals, both grain and grasses. Its presence in the soil is consequently to be considered as a condition of fertility. It has a powerful tendency to augment the consolidation and tenacity of land, and its power of retaining water. It also promotes the putrefaction and decomposition of humus, and the reciprocal action of the fluids or nutritive juices contained in the soil, and imparts its carbonic acid to the humus, or even to the plant itself.

The hull or epidermis enveloping the farinaceous portions of grain grown on soil in which there is a due admixture of calcareous matter, and the farina itself is much greater in quantity and richer in quality than in grain grown on lands which exhibit a deficiency of this earth.

The excellent quality of the wheat grown to day on the far western prairies, beyond the Missouri, in Texas, Kansas and Nebraska, is due to the fact that over those regions there extends great limestone zones, destined to be the most important wheat fields of the continent, which experience is demonstrating yearly, as each season the "golden belt" is pushed farther westward.

The civilization and subjection of the "Great American Plains" to the uses of man, is not then a question of inherent fertility of soil, but of aridity of climate, and possibility of ameliorating changes through his agency, in the creation of forests, and improved systems of irrigation, upon which depends the solution of the question.

The effects of forests upon climate are manifold, and in those countries from which they have been ruthlessly torn by the ignorance of man we may read a lesson how climate is modified by their presence, and how the vast interior area of the United States, if it can be clothed with arborescent forms, will be metamorphosed into the best agricultural region of the continent.

The presence of forests shelter the earth's surface, through the agency of their dense foliage, from the scorching heat of the sun. It has been conclusively shown how they act as a source of the perpetual supply of springs. They break the force of the wind in an astonishing degree, and are the direct medium in the retention of moisture over areas within their influence.

Becquerel states: "That in the valley of the Rhone, a single hedge two metres (a little more than five and a half feet) in height, is sufficient protection for a distance of twenty-two metres (seventy-two feet) in length."

On the prairies of Texas, Kansas and Nebraska, a narrow belt of Osage orange, or a double row of cottonwood or peach trees, as is well known in the experience of the inhabitants of those localities, is an effectual barrier against the high spring winds of the plains for comparatively extended distances, and the effects of this wind-break are felt at a considerable elevation above the height of the trees or shrubs which compose it.

These wind-breaks, as they are called on the plains, protect equally from the not infrequent furious storms of winter, and the occasional hot winds of summer. In winter, too, the snow is piled up in great drifts, parallel to the hedge or row of trees, and thus deposited, prevent the frost for some distance from bursting the ground open; in the spring the snow melts slowly away and soaks the earth thoroughly; instead of immense creeks, occasioned by the action of the frost, as in exposed situations, swallowing the rains of that season without doing a particle of benefit, the precipitated moisture is evenly distributed, and the earth in a condition to retain it. In summer, the air in the immediate region of these timber belts is cool, and the soil in the vicinity retains its moisture for a long time relatively.

Marsh* says, in regard to the effect of trees as a barrier to the wind: "* * there is no doubt that the effect of cold blasts can be greatly mitigated, and observation shows, that while the tops of the trees are swayed by their violence, the surface will be found calm and warm. * *"

The constant presence of moisture in forests will be admitted by the most careless observer who has ever lived in a timbered country. This moisture, as a matter of course, must be constantly evaporating, and consequently modifies the heat of the surrounding region. The compact foliage of the forest condenses the moisture from the passing breezes, and refreshing showers on the contiguous country is the result; were it not for this mass of cooler matter thus presented to the actions of the winds in their transit over the region, there would be no condensation, or at least but little, of their aqueous vapor; in a district, therefore, destitute of timber, though the currents which sweep over it be fairly freighted with moisture, they part with but little of it, and that portion of a continent would fall under the odium of a "barren waste." This appears to have been the condition of a large portion of the prairie area beyond the ninety-eighth meridian primarily, but which is changing, and rapidly succumbing to the influence of civilization; every tree, every shrub planted, every acre that is turned

*Man and Nature.

over to the sun, performs its part in the wonderful metamorphosis that is taking place.

The roots of trees penetrate deeply into the reserve of moisture below the surface of the earth, and constantly draw by capillary attraction a portion of it which is exuded by the leaves, and the humidity of the air increases, as explained above, and the temperature lowered.

Shacht says: "In wooded countries the atmosphere is generally humid, and rain and dew fertilize the soil. As the lightning-rod abstracts the electric fluid from a stormy sky, so the forest abstracts to itself the rain from the clouds, which in falling refreshes, not it alone, but extends its benefits to the neighboring fields. * * The forest, presenting a considerable surface for evaporation, gives to its own soil and to all the adjacent soil, an abundant and enlivening dew There falls, it is true, less dew on a tall and thick wood than on the surrounding meadows, which being more highly heated during the day by the difference of insulation, cool with greater rapidity by radiation. But it must be remarked, that this increased deposition of dew on the neighboring fields is partly due to the forests themselves; for the dew saturated strata of air which hover over the woods, descend in cool, calm evenings, like clouds, to the valley, and in the morning beads of dew sparkle on the leaves of the grass and the flowers of the fields. Forests, in a word, exert in the interior of continents an influence like that of the sea on the climate of islands and of coasts; both water the soil, and thereby insure its fertility."

This phenomenon of the condensation of dew is witnessed to-day on the prairies beyond the Missouri as far as civilization has reached, and it appears to be the result of causes analagous to those ascribed to the presence of forests; large areas of corn and immense fields of the other cereals, presenting the same conditions, in a reduced ratio, however, as belts of woods; at any rate, lands where ten years ago the presence of dew could not be detected, now receive this blessing in full measure, showing that the changes produced in the nature of the vegetation by the progress of civilization, the cultivation of forms superior to the low grasses of the region in its primitiveness, are sufficient in increased surface presented for evaporation to condense that which is thus extracted in the form of dew, and thus save for the fertilization of the soil that which was once carried off by the atmosphere for the support of other regions.

The absolutely cloudless skies, nights which knew not the refreshing indraught of the beaded dew, the wonderful pictures of the mirage, and the stifling heat of the noon-day sun, were the peculiar characteristics of the climate of the plains, as narrated in the reports of the early explorers, and to-day, in a certain degree, these are the distinguishing features of a large portion of the interior of the continent. But great changes have been wrought by the presence of man, and his power to subordinate nature to his use is so mighty that even the elements seem to bow to his imperial will.

The railroad was the potent *avant courier* of the wonderful civilization which was so soon to follow in its wake, and although at first the hardy pioneer stepped

hesitatingly within the mysterious domain spreading out almost illimitably before him, he found that his prospective desert only needed the magic touch of the genius of agriculture to convert it into a garden; and so the hundreds of thousands who have followed his footsteps here on the "iron trail," and with the speed of the wind, are helping to build up that vast empire which is the destiny of that portion of our country.

"The plow has invaded the plains and has conquered," says my eloquent friend Col. Elliott. At intervals for six hundred miles beyond the Missouri, thriving villages have sprung up whose metropolitan aspect and rapid growth are marvels of the nineteenth century. Around these centers of civilization, and far beyond the ninety-eighth meridian too, under the munificent laws governing the disposition of the public domain, the whole territory is rapidly being converted into an agricultural region which promises the grandest results. Wherever the rich sod of these magnificent natural fields is brought under the empire of the plow, nearly every variety of vegetation which characterizes the primitive prairie retreats like the original owners of the soil before the conquering tread of the white man.

Nature has furnished in these far-stretching plains almost every variety of soil, but with a characteristic inherent fertility whose productiveness approaches, under a true system of agriculture, the marvellous.

Nowhere on the American continent does the opportunity for a diversified agriculture present itself as on the prairies of the far-west. All the cereals can be successfully grown on the rich bottom lands, or on the equally fertile elevated divides which separate the valleys.

Altitude above the sea level seems to enter largely into the problem of fruit culture, and the possibilities in this direction are only limited to varieties as we approach the more lofty plateaus westward.

That the forest may be extended over the major portions of the great plains in areas sufficiently large to effect the climatic changes which their presence induces, is believed not only possible, but probable, if we can predicate from the progress already made in this particular. Where the sun for centuries has poured down his rays upon the carpet of short grass, or upon the brown and rusty earth; where the rustling of leaves in the spring time is never heard, and where the solitary smoke of the red man's wigwam oftentimes constituted the only cloud in the whole expanse of the clear blue sky—man in his "hunger for the horizon," as Senator Ingalls, of this State, so eloquently expressed the march of the hardy yeomen of the Eastern slope who are pressing upon the foot-steps of the receding savage, will find the land now "full of harvests and green meadows," either through the agency his presence exerts in changing the climate, or by a system of irrigation his genius commands.

Two-thirds of the length of the Great Plains, east and west, from far north of the Platte, to their extreme southern border in Texas, is already productive, as a tour through that region or reference to authentic statistics will confirm. I have argued in the affirmative for the districts away to the mountain slopes which

are now only covered with grass, that in its entirety it is not condemned for all time to a mere pasturage. The plains are not sterile as was and is believed by many to-day. Their proportion of unproductive land in consequence of inaccessible bluffs or rocky mesas is less than in any other equal area on the globe. Portions of the far-off plains are only comparatively arid; with precipitated moisture in sufficient measure—which will in time come—or water through the medium of irrigation, the richest agricultural results are assured. That the whole of the vast interior arêa of the continent will become habitable as rapidly as the demands of civilization require, we should have no doubt. When the limit of sufficient precipitated moisture is reached, or where the timber will not grow spontaneously—for that will be the line of demarcation—but which has not yet been determined—then the available streams and rivers of the region must be used for irrigation.

The remarkable excess in inches of the spring and summer rains over those of autumn and winter, and which have persistently increased in measure as civilization pushes towards the mountains, have permitted thousands of farms to be opened far beyond the ninety-eighth meridian, whose productiveness in corn, wheat and other cereals have astonished the world, justifies the assertion that the limit where a sufficiency of aqueous precipitation ceases, and irrigation must be depended upon, is not yet reached. Whether that will be attained until the actual slopes of the mountains are compressed, as is confidently believed by some, cannot yet be determined. The writer does not accept that theory fully, on account of apparently dominant adversely controlling forces in the immediate locality of lofty ranges, though he does not deny the possibility of the truth of the theory.

At the foot of the mountain slopes the streams have already been utilized for the purpose of irrigation most successfully, flowing as they do in so many pleasant lines from the rainy and snowy heights of the Rocky range, and this system of cultivation will spread eastward to meet the progress of civilization that is rapidly moving westward until the lines of sufficient precipitation meet those of irrigation, and the hiatus now existing between the advancing armies of permanent occupation is closed.

To many who have not studied the changes that are taking place on the great plains, it probably seems a curious and presumptive proposition that they are destined to become the principal food-producing regions of the Continent—perhaps, of the world—but the idea will not appear so unwarrantable when we reflect how rapidly their agricultural proclivities are being developed and that the theories of the laboratory and the speculations of the professor's study in relation to them are sadly in opposition to the truth; facts are answering the problems of that region with more effect than philosophy.

It makes no difference in the solution of the proposition, that the whole interior portion of the United States under consideration will be made habitable, whether the necessary changes which are to effect the result are slow or rapid; it is an established fact, however, that as civilization reaches out into the wilderness

with confident tread there is no retrograde march; it is ever onward, life is sustained and communities spring up and prosper.

On the broad prairies beyond the Missouri, water is found in abundance, either in rivers, streams, springs, spring-fed pools, or can be obtained by digging wells at inconsiderable depths. In the important relations of this article, therefore, to human economy, the people of those regions need entertain no doubts on the subject of a sufficient supply. This is an important consideration in discussing the possibilities of forest culture, and upon this fact and the power of the soil of the plains to retain moisture, coupled with the supply beneath the surface, into which the roots of the trees will send their delicate tubes and receive their nourishment in part, is predicated the sneers met with already, and the assurance of further operations in this direction. It is not an improbable theory that beneath the area of the great plains there are considerable streams flowing eastward, at intervals, over their whole breadth, which, under certain aspects, serve in the economy of the moisture of those regions. This was a favorite theme of the late Professor J. W. Foster, LL. D., of Chicago.* I do not know whether it was ever promulgated by him in any of his works, or only conceived after he became too ill to write, but I recall a conversation with him, a short time before his death, on the subject of the source of supply of the Great Lakes, in which he thought that a possible answer might be found in subterranean streams whose reservoirs were the excess of the precipitation in the mountain ranges of the far West over the amount of the evaporation and that carried away by the visible conduits of the region.

As two confirmatory proofs of the plausibility of subterranean streams flowing far to the east of the mountains, I offer the following facts, the first of which came under my own observation, the second under that of a scientific friend: Upon a high "divide" between the Smoky Hill and Saline rivers, in Western Kansas, on the northern edge of the water-sheds of the cañons of the Saline, the Kansas Pacific railway company bored for water some years since, unsuccessfully, after attaining a considerable depth; this was in the fall. An examination of the physical formation of the immediate locality partially explains the reason why they failed to reach the veins running at the usual distance, thirty to sixty feet. The bore was located upon the extreme limit of an inclined plane sloping south to the Smoky Hill. On the northern rim of this plane the Saline has cut its channel more than three hundred feet below the level of the well's mouth; on the south the Smoky Hill flows over two hundred feet below at the foot of the slope, seven miles away. The water courses of that district, both above and below the surface flow to the south into the Smoky Hill, and not, as would superficially appear most natural, into the Saline. Underneath the surface, at an average depth of thirty feet, lies the shale, above which, but never in, all the water of the wells is found. To the west and to the east the plane is cut down to the shale beds by streams and cañons which deprive this plane of its supply of water

*President of the American Association for the Advancement of Science, Lecturer on Physical Geography, Author of the Mississippi Valley, &c.

except by the infiltration of precipitated moisture, but there is not sufficient area to furnish this well on the theory of infiltration of rain. At the time of the spring freshets, caused by the melting of the snow in the mountains, this well overflows, and when the period of the freshets has passed and the streams in that region assume their normal level, the water of the well subsides until the next season of freshets when the same phenomenon is presented, and thus keeps up its intermittent character. The other phenomenon was witnessed by a friend, as stated, in Chicago. In building one of the light-houses on the shore of Lake Michigan, near that city, it became necessary to make the foundation of piles, and, after the circular group had been placed in position and an attempt was made to drive the last and center pile, it apparently broke through a crust or shell and disappeared. A cord and plummet was sunk through the opening and a swift running stream was discovered flowing into the lake.

The writer's experience on the plains, west of the ninety-eighth meridian, ten years ago, seemed to warrant the assertion, even then, that there was a larger amount of humidity in the atmosphere of that region than a superficial observation would concede. Clouds formed every day, and in the summer, the most decided indications of showers would present themselves, but would pass off without precipitating their refreshing drops on the earnest earth, this phenomenon proved sufficient moisture, but the conditions necessary to force precipitation were absent. With the introduction of the plow, and the cultivation of crops and forest plantations, a wonderful change has taken place; now it is the rule, where before it was the exception, for the clouds to precipitate their moisture, and showers are frequent; then a storm could be seen forming, and "the rain, like a curtain," suspended in mid-air, but rarely reaching the earth, re-vaporization apparently arresting the shower on its course to the ground; now this curious meteorological scene is rarely witnessed in the settled area, and disappears as civilization moves onward.

The fact must not be overlooked that the mere breaking up of large areas by the plow in the prairie region has been an effective agent in the phenomena of climatic changes. The moisture, instead of being rapidly drained into the ravines and water-courses, has sunk into the soil and furnished nourishment for the new vegetation which shades the ground more perfectly than the grasses and presents a larger surface for the condensation of the atmospheric humidity in the form of dew. The reflection of heat has been modified and the floating moisture has been attracted to the earth in the same manner as the electrical fluid is drawn to a good conductor. When we consider how many square miles of territory are each year turned over, we cannot but admit the truth of the belief that the disturbance of the soil enters largely as a factor in the problem of ameliorating causes.

Extensive tree growth on the plains has unquestionably sensibly affected the climate and brought about the varied phenomena attributed to the presence of forests, and the argument of the possibilities of success in clothing the grassy

prairies beyond the Missouri with arborescent forms depends only upon a proper system of culture, and a true conception of its importance.

The results of timber growth on the prairies of the far-west, and into the "desert" of the early writers, is something astonishing. Want of space precludes the idea originally intended of tabulating what the writer has observed, but a visit to those regions will disclose to the most casual looker on a remarkable picture of incipient forest to-day, either on the bottoms or on the uplands of any locality where civilization has established itself.

These groves of puny timber, far beyond the ninety-eighth meridian, have in some sections already given, to the traveler passing through, the appearance of a wooded country. More than three hundred miles beyond the Missouri, in Kansas, at an altitude of over two thousand feet above the sea level, the young tree plantations of cottonwood have made in two years a growth of from eight to twelve feet; the box-elder from three to six, and the white ash about two feet. All of these varieties are indigenous, and are found fringing the streams, from which localities the seeds are gathered and the slips cut. Apples and peaches have been raised successfully for some years on and beyond the ninety-eighth meridian, and, still farther west, cherries and peaches in the new settlements have come into bearing. The wild plum which grows in profusion far beyond the ninety-eighth meridian, rivals its domestic brother of the old orchards of the east; so much so that some which the writer had forwarded for exhibition at the Centennial, in the Kansas display, were pronounced by Hon. A. Gray, Secretary of the State Board, superior to the cultivated species.

The prairie soil seems to possess a wonderful inherent power in the development of root-growth. In 1866 or 1867, the students of the Commercial College at Topeka, established a short line of telegraph for the purpose of instruction, and used as one of the poles a green cottonwood six or seven inches in diameter, sawed square at both ends, and denuded of its limbs. This log—for it could not be called anything else—was set up on the main street, on the high ridge on which the town is built, and far from any water-course. It took root, and to-day is a magnificent tree twenty inches in diameter, with huge, overspreading branches, and taller than the fine buildings in the vicinity; in fact, I am told that the limbs have been cut back repeatedly, so rapid has been its growth.

A favorite method of commencing forest plantations in many portions of the prairie region beyond the Missouri, is to plow under green saplings deprived of their limbs and notched at intervals, from which a shoot appears above the ground and takes root as the parent stem decays.

The rapidity with which forests can be made to reach proportions that will have a visible effect on the climate of a region, is remarkable, and the relatively short period required to bring about these conditions on the plains, has been one of the greatest incentives to forest growth on the prairies of the far-west. Time, then, does not enter so largely into the problem as one would at first imagine, and this fact is being duly appreciated by the pioneer civilization of the country beyond the Missouri.

Prof. Hayden,* in his geological survey of Nebraska, "examined young cottonwoods ten years old from the seed, measuring fifty feet in height, and four feet in circumference; others of the same age, two feet, eleven inches in circumference, and thirty feet high; at eight years old, two feet, eight inches in circumference; at four years old, eighteen inches in circumference and twenty feet high; and at seven years old, two feet, one inch in circumference, and fifteen feet high. Soft maple of ten years growth, two feet, eight inches in circumference, and thirty feet heigh; at seven years old, two feet, one inch in circumference, and fifteen feet high. Common locust of ten years growth, two feet, five inches in circumference, and fifteen to twenty feet high; five years from seed, twenty-three inches in circumference. Black walnut, ten years from seed, thirteen inches in circumference and fifteen feet high. Box elder ten years old, two feet, two inches in circumference. Equally good results have been obtained in Kansas, and in the valley of Salt Lake where irrigation is practised. * * "

The writer recalls to memory one grove beyond the ninety-eighth meridian which during the last ten years has been cut down and grew up, at least three times, and the material hauled off for fire-wood, the trees at each cutting having attained a heighth of from five to twelve feet. If this belt had been permitted to remain unmolested, it would have been by this time a dense woods.

It seems to be possible, that under the proper conditions of culture, these young forests may be extended to the foot of the mountains, as the single trees, hedges and groves first planted by the settler, in connection with his extensive disturbance of the soil, bring about such changes, that as the conquest of the prairie is advanced, the forest belt is pushed out with it. The first tentative attempts at hedges and little door-yard clumps, acquire the power of retaining, not only the local humidity, but of attracting and precipitating that which the winds bear, which, without the presence of the trees, would have passed over the region as dry winds. Deluging storms occur less frequently, and the rain does not run off the cultivated surface, as rapidly as when the comparatively hard and baked earth alone was presented to the shower. Evaporation from the earth directly, as well as through the medium of the vegetation, takes place throughout the seasons, and where once, too, the sun shone through an atmosphere apparently devoid of sufficient humidity even for the condensation of dew.

Horace Greely wrote in the *Tribune*, on one occasion after a trip on the "Great American Plains:" "I have a firm faith that all the great deserts of the Temperate and Torrid zones will yet be reclaimed by irrigation and tree planting."

It will be conceded that the possibilities of forest growth on the Great Plains, as has been hurriedly shown, are not inconsistent with the view presented in this paper on the "Origin of Prairies;" that they are due to insufficient precipitated moisture, which is undoubtedly the cause of their treelessness, not, however, for the reason that the absolute precipitation is not enough to sustain tree growth when once inaugurated and guarded by conditions, for on at least a larger portion

*Report of the Secretary of the Interior, 1868.

of the whole interior prairie area, and far beyond the hundredth meridian, too, but because it is not sufficient in measure to protect the young shoots from destruction by fire; far east of the ninety-eighth meridian, and far west of it too, it is the universal rule where the annual fires are stopped tree growth soon begins, and to-day extensive groves can be seen remote from water courses, that have thus spontaneously sprung up as it were.

Far beyond there is a region, however, where, as observed previously, the annual fires do not affect the question of the encroachment of the timber on the prairie, contiguous to the streams to which it is rigidly confined; but even there, as civilization pushes forward, such ameliorating changes occur, and forest plantations thrive so flourishingly, as apparently to stultify all previously conceived theories.

The increase in the volume and persistency of streams on the prairies, is a fact vouched for by the experience and observations of thousands who live in the region beyond the Missouri, and that this phenomenon is directly attributable to the civilizing influences at work in the cultivation of timber, the disturbance of the soil, and other allied energies of frontier settlement, must be conceded with all the precedents of history before us. My own observations on the plains, west of the ninety-eighth meridian, during an almost continuous residence of twelve years, in which time the settlements have pushed forward, and large agricultural districts been opened up on the so called desert, confirm the assertion that the volume of water in the streams has perceptibly increased. Small tributaries to the principal rivers, whose sources are springs which flowed formerly only periodically, have become constant, and the beds through which the water found its passage at certain seasons—the remainder of the year being absolutely dry—now maintain a continuous current Depressions in the prairie at the foot of inconsiderable bluffs, which in the spring alone contained water (called water holes by stockmen), but which in the early summer became dry, are now permanent pools with a spring-like energy. Hon. Jacob Stotler, editor of the *Emporia News*, who has resided in that portion of Kansas for twenty-one years, informs me that the "Cottonwood" before and up to 1857–8, "could be crossed on the riffles dry-shod anywhere." Since that time, he says, and with the settlement of the country, the volume of water has increased yearly, and from that date he does not remember, at its driest stage, for any time during the last ten years that there has been less than eight or twelve inches of water in the shallowest places. Mr. Stotler also called my attention to a grist mill established on that stream many years ago, that frequently had to stop in consequence of the scarcity of water, but for the past decade, notwithstanding an increased demand upon the power, has experienced no difficulty in that particular, never since having been compelled to suspend from that cause.

In discussing the agricultural possibilities of the Great Plains, Rev. J. A. Anderson, of the Manhattan college, argues thus: "When a man harvests twenty bushels of wheat to the acre, that fact is quite as satisfactory to him as any analysis of the soil, or any record of the rain-gauge. And if through a

period of years, this fact repeats itself as often as in those states where an experience of generations has demonstrated their adaptation to wheat raising, he would disbelieve any assertion not in unison with the facts. On the one hand, he would be slow to expect that his field could average seventy bushels to the acre; on the other hand, he would laugh at the statement that the soil was too poor, or the supply of rain too small for profitable wheat growing. However valuable the facts and theories of the general science relating to agriculture may be, and many of them are valuable, still the best of all possible evidence to any practical man is the bins and the ledgers." With just such logic, and faith in the kind of prayer that taking hold of the plow-handles believes in the immutability of nature's laws, are people filling up the prairies of Texas, Kansas, Nebraska, Colorado, Dakota, Wyoming and Montana, satisfied with, and proving better than any theory worked out in the studies of the scientists, that the Great Plains are intended for the habitation of man, but to be wrought out by his immortal genius, through which he will yet see grand states grow up among the rocky peaks, and in the interior of the continent hitherto considered a desert and a waste.

We must be convinced in face of the facts presented that the climate west of the Missouri has changed, and that this change coincides with the advance of civilization into the interior prairie region. It is certain that the rain-fall has increased, and if the influences are correctly assigned, the ameliorating modifications will be progressive over the whole central area. Each season witnesses a larger portion of the whole domain subjected to the demands of the inrushing immigration, and greater encroachments of the forest growth. In Texas, Kansas, Colorado, Nebraska, Wyoming, Dakota, Montana and Utah, these modifying influences are extending, and it is no wild flight of the imagination to predict such corrective changes as are witnessed to-day over portions of the interior of the continent, for the entire prairie region, and the results obtained justifies the belief that the creation of forests through the agency of man in a district primarily devoid of trees, will bring about conditions the opposite of those which a like agency in other countries has effected by destroying them.

Illinois, Iowa, Minnesota and portions of Ohio, are confirmatory proof of the argument that civilization ameliorates climate. Increased growth of timber in those states has resulted in greater regulating and more equable distribution in the rain-fall. In the early settlement of Iowa, twenty-five years ago, that state was the theater of destructive inundations, excessive drouths, and sudden changes of temperature; all these phenomena have disappeared in a remarkable degree. Eastern Kansas, Nebraska, Colorado, in the vicinity of Denver, Eastern Texas and the great Salt Lake Valley; in short, in all localities of the "Western Wilds" where civilization has established itself, nature has evinced her readiness to second man in his efforts to subdue the primitive region to his uses; and the changes the above mentioned districts have experienced, the region in the Central Plains is experiencing, although it is only ten years since the immigrant wandered into their confines.

The indigenous trees of the plains west of the ninety-eighth meridian, are

not limited to a few species, but exhibit all the varieties necessary to meet the requirements of the vast civilization that is gradually investing that region, and the difficult experiment of transplanting exotics to maintain forest growths is not an obstacle to the possibilities of timber culture. The immigrant has only to avail himself of the seeds, or young shoots, which he finds at his hands, to commence his tree plantation; and it is perhaps to this fact that such a large area is already devoted to timber.

European nations have awakened to the importance of the preservation of existing forests and the creation of new forests as an agency in the amelioration of climate, and rigid laws have been enacted and are in operation to-day in France, Germany and Russia. Not only are these laws applicable to the public domain in those countries, but their effect reaches the estates of individuals, so thoroughly alive to the relations which forests maintain to climate are the authorities.

Institutions devoted entirely to scientific forest culture have been established at more than a dozen places in Germany, and in France over four thousand salaried officers are attached to the "Bureau Central de'l Administration General des Forêts." In these institutions the professors are persons of the highest scholarship. Lectures are regularly delivered on all the coördinate branches of forest culture: the principles of forests, measurement of forests, forest nursery, vegetable physiology, forest botany, forest microscopy, forest zoölogy and entomology; in short everything which relates to the subject in its minutest details. In France the "Gardès Genevare" number nearly five thousand, who perform the work of the public forests under the direction of the central office in Paris.

The Russian government has attempted the difficult problem of extending forest growth over the steppes, a region of drifty sands, and has met with perfect success, as the many thriving forests of timber reported in existence there attest.

The majority of the planted forests of Europe are in a region whose soil is infinitely inferior to that of the poorest of the western plains. In the sandy tracts of Northern Germany, "from Berlin to the Baltic and the German Ocean, including the Prussian provinces of East and West Prussia, Pomerania, Mecklenburg-Schwerin and Mark Brandenburg and the kingdom of Hanover, are in many places covered with deep sand, lying upon the surface so loose as to be moved about by the action of the wind like the billows of the sea." In this really desert-aspect region are found the finest artificial forests in the world.

In France, on the western coast, are immense sand hills, sometimes attaining a height of three hundred feet, and here, as well as on the sand dunes of Gascony, dense forests have been planted, which stand in a soil of pure sand, but which are growing luxuriantly, and are reclaiming a region which had always heretofore been regarded as hopelessly sterile.

One authority says: "The dune lands and sand plains of that country, estimated as equal to about twice the area of Maryland, or as covering more than thirteen million acres, most of them naturally as arid as the Llano Estacado of Northwestern Texas, are being everywhere brought under cultivation by planting them with pine."

Geology proves that the Russian steppes, like our own great plains, were never covered with trees, and, like the plains, were the homes of nomadic tribes —the Scythians—who wandered over the prairies as the American Indian. In climate, too, the steppes are similar to our own western regions, primarily fruitful in intense drouths and fearful storms.

Infinitely more inherently fertile than any region in Europe where forest culture has met with such success, the great American plains promise the most wonderful results in timber growth, and a few years will effect the most marvelous changes in their adaptability to the uses of man. The sandiest of deserts contain abundant supplies of water under their areas usually, even where no evidences of moisture are visible on their surfaces, and timber culture whenever extended in these regions has definitely determined the question of their possibilities in that direction favorably; how much more may we expect on the prairies of the Far West, whose whole surface is abundantly watered.

On the west coast of Africa the dunes of sand are quite moist a short distance below their exterior, and under the dunes of Algeria there is an abundance of water. On the Great Sahara the French find water at accessible depths. The several Pacific railroads have experienced no difficulty in establishing permanent wells along their lines wherever needed and at moderate depths, from which the water is raised by means of the most simply constructed windmills. Underneath nearly the entire area of the plains, at a distance of from ten to twelve feet, there is a stratum of soil containing sufficient moisture to sustain tree growth, and into this their rootlets strike and are nourished.

Viewing the results of the efforts made in Europe in the artificial creation of forests, it would appear that we need have no fears in this connection even for the dreaded Llano Estacado, which approaches nearer in its physical aspect to a desert than any other portion of our interior area, not excepting the Mauvaises Terres of Dakota and Montana.

General Pope thus describes the remarkable region of the Llano Estacado:* * * "Proceeding westward, the most desolate portions of the United States, known as the Llano Estacado or *Staked Plain*—a treeless plateau elevated four thousand feet above the sea, a hundred miles or more in breadth, and stretching from the Canadian to beyond the northern confines of Mexico, unbroken by a single peak and underlaid by a nearly horizontal strata of red clay and gypsum. It is without wood or water. For thirty miles of the Pecos the surface is hard and covered with grama grass; and from thence to a point about thirty miles west of the Colorado of Texas, the hard surface alternates with patches of dark red sand, covered with bunch grass. The Llano Estacado presents no inducements to cultivation."

This is the gloomy view taken of that portion of our country twenty-five years ago, long before the idea was fully developed in Europe of redeeming sterile and desert lands by the introduction of timber. When we compare the Llano Estacado, with its carpet of grass, to the absolute deserts of Algeria and the

* Pacific R. R. Survey, 1852.

Great Sahara, and mark what the French government and Mehemet Ali have effected by the agency of man in reclaiming those reaches of drifty sands, we may predict equal possibilities for the Llano Estacado with its elements of fertility.

Over twenty millions of trees have been planted in the deserts of the Nile and their productive area extended wonderfully, and immense date groves, within the last twenty years, have sprung up at intervals on the Great Sahara, irrigated by artesian wells and surrounded by thrifty plantations.

General Emory, describing the Moro Valley, says: †"The plains were strewn with brick-dust, colored lava, scoria and slag; the hills to the left capped with white, granular quartz. The plains are almost destitute of vegetation; the hills bear a stunted growth of piñon and red cedar."

This valley is now one of the richest wheat-producing regions of New Mexico, and when the writer visited it ten years ago, its thriving villages and fine farms presented a curious contrast to the desolate picture drawn as above in 1846.

In the report of the Geological Surveys of the Territories,* Professor Cyrus Thomas in his investigations of the agricultural possibilities of the regions included in the surveys, says: "In calculating the probable development of the same, it is necessary to lay aside to a great extent all our ideas of agriculture based upon experience in the States. For, not only are the physical aspects of this portion of the West so different from the eastern half of our country as to strike the most superficial observer, but the climate is almost completely reversed, the thermometric and hygrometric conditions bearing no such relations to vegetation and agriculture here as there. Hence, the criteria by which we judge the fertility and productiveness of the soil and its adaptation to given products (except, perhaps, the strictly chemical tests) do not hold good here. The pale appearance of the soil, the barren look and stunted growth of a spot, are by no means conclusive evidences of its sterility, for the application of water may show it to be rich in vegetative force." Professor Thomas hints at the incorrectness of the earlier official reports on the subject of the Great Plains (as plainly asserted by myself), "that the primitive explorers condemned, in too hasty and general terms, the possibilities of that whole region to the uses of man, dwelling upon its desolateness and sterility in most emphatic terms."

Let us turn once more to some of the historic facts connected with the disboscation of a country and the alleged meteorological effects of thus disrobing a region of its timber.

M. Becquerel, of the French Institute, an unquestionable authority, says: "The effects of disboscation on the sources and quantities of living water which irrigate a country are of the most important consideration, and hence require serious attention. The difficulty in verifying these effects is the greater, inasmuch as it is impossible to say *a priori*, whether a forest or portion of a forest, destined to be cleared away, contributes to supply such or such a source, such or such a river. Springs are owing in general to the infiltration of rain-water in a previous formation, through which this water sinks until it meets with an impervious stra-

† Reconnoissances in New Mexico and California, 1846. * F. V. Hayden, U. S. Geologist, Report of 1870.

tum, flowing over the latter when it is in an inclined position, and eventually rising in streams or fountains; the water of wells has the same origin. Large springs are ordinarily found in mountainous regions. Forests also contribute to the formation of springs, not only by reason of the humidity which they produce and the obstacles which they oppose to the evaporation of the water which falls on the surface, but further because the roots of the trees, which, by dividing the soil render it more pervious, and thus facilitate infiltration."

Strabo informs us that it was necessary to take great precaution to prevent the country of Babylonia from being submerged. The Euphrates, which begins to swell, he tells us, at the close of spring, when the snow melts on the mountains of Armenia, overflows at the beginning of summer, and would necessarily form vast accumulations of water on the cultivated lands were not the superflux turned aside by means of trenches; this state of things exists no longer. M. Oppert, who, some years ago, traveled all through Babylonia, reports that the volume of water conveyed by the Euphrates is much less than in past ages, that inundations no longer occur, that the canals are dry, the marshes exhausted by the great heats of summer, and that the country has ceased to be insalubrious. This retreat of the water can only be attributed, as he found means to satisfy himself, to the clearing away of the forests on the mountains of Armenia.

DeSaussure† long ago pointed out the diminution of the water of the lakes of Switzerland—especially in lakes Morat, Neufchatel and Bienne, as a consequence of the clearing away of the forests.

Choiseul Gouffier was not able to distinguish in the Troad the river Scamander, which was still navigable in the time of Pliny. Its bed is now entirely dry; but the cedars also, which covered Mount Ida, whence it took its source, as well as the Simois, exist no longer * * *

M. Boussingault cites several examples leading to the same conclusions, but I will offer only two: "In 1826 the metalliferous mountains of Marmato presented only some miserable cabins inhabited by negro slaves. In 1830 this state of things no longer existed; there were numerous workshops and a population of three thousand inhabitants. It had been found necessary to level much wood; this denudation had proceeded but two years, and already a diminution was perceptible in the volume of water available for the labor of the machines." The other example cited by the same distinguished authority was furnished from the high table-lands of New Granada, elevated from six thousand to ten thousand feet above the sea level: "The inhabitants of the village of Dubatè, situated near two lakes, which were united sixty years ago, have witnessed the gradual subsidence of the waters, insomuch that lands which, thirty years ago, were under water are now subject to culture." M. Boussingault satisfied himself by a most rigid investigation that the diminution of the water in the lakes was caused by the extensive removal of forests in that vicinity. He found at the same time that Lake Tota, not far from Fuquene in that country, in a locality where the woods had not been disturbed, had suffered no loss in the volume of its water.

M. Desbassyres de Richemont states* that in the Island of Ascension a mag-

†Voyage dans les Alpes. *Cours d'Agriculture de M. deGasparin.

nificent water-source was desiccated in consequence of the destruction of the forest near by, which, however, flowed again and regained its full force upon the restoration of the timber.

From 1778 to 1835, in the Oder, and from 1828 to 1836, in the Elbe, the volume of water materially decreased so much so that Mr. Berghaus calculated that should it continue in the same ratio for a number of years it would force a "change in the construction of boats," but in this case it was not fully attributed to disboscation.

In the time of the Romans it is known they brought water from the fountain of Etureé to Orleans, but now that fountain is perfectly dry. An authority says: "Extensive excavations made within a few years have brought to light the foundations of Roman constructions where no source of water any longer exists; a stream, moreover, to the east of Orleans, which contributed to the defense of the city during the siege of 1428, and which was considerable enough to turn mills, has completely disappeared; now, on that side of Orleans there were great forests which have been cleared away. In consequence of these clearings, the wells of the city have continued to yield less and less water, so that the municipal administration has been obliged to incur an expense of three hundred thousand francs in order to bring potable water from the source of the Loire."

Bolando, in writing of the redwoods of California, says: "It is my firm conviction that if the redwoods are destroyed (and they necessarily will be, unless protected by the wise action of our government,) California will become a desert in the true sense of the word. In their safety depends the future welfare of the state; they are our safeguard. It remains to be seen whether we shall be benefited or not by the horrible experience which such countries as Asia Minor, Greece, Spain and France have made, by barbarously destroying their woods and forests. Wise governments would be able to replace them in those countries, but no power on earth can replace the woods of California when once completely destroyed."

*"Once a great pine forest bound with its roots the dune sand and the heath uninterruptedly from Danzig to Pillau. King Frederick William I. was in want of money. A certain Herr Von Koff promised to procure it for him without loan or taxes if he could be allowed to remove something quite useless. He thinned out the forests of Prussia, which then, indeed, possessed little pecuniary value; but he felled the entire woods of the 'Frische Nehrung,' so far as they lay in the Prussian territory. The financial operation was a success; the King had money, but in the elementary operation which resulted from it the state received irreparable injury. The sea winds rushed over the bared hills; the Frische Haff is half choked with sand; the channel between Elbing, the sea and Königsberg is endangered and the fisheries in the Haff injured. The operation of Herr Von Koff brought the King two hundred thousand thalers; the state would now willingly expend millions to restore the forest again."

This branch of the subject is so intensely interesting that it is with regret I

*"Man and Nature."[MARSH.

feel compelled to omit the mass of testimony I have collected from the most reliable sources, and which I deem necessary to a complete discussion of the question, for it is only by a rigid examination of authentic data that we are able to reach correct conclusions. To accomplish what I desired originally is impossible in the scope of a magazine, and we must be content with a mere skimming of the surface, which is all this article aspires to.

It is not within the province of this paper to enlarge upon the terrific destruction of timber in the forest regions of the United States, and the dire results that must inevitably follow if we can rely upon the light which history has thrown upon the subject of disboscation. But the lament will come from the next generation, as some writer has truthfully expressed it: "The people of this will only boast the swift change of the wood and the wilderness to the fertile field, and exult in the lines of towns and cities which spring up along its water-courses and overlook its lakes."

Three hundred years ago, Palissy, recognizing the indifference of present to future generations in this wanton destruction of forests, wrote: "When I consider the value of the least clump of trees, or even thorns, I much marvel at the great ignorance of men, who, as it seemeth, do nowaday study only to break down, fell and waste the fair forests which their forefathers did guard so closely. I would think no evil of them for cutting down the woods did they but replant again some part of them, but they care not for the time to come, neither reck they of the great damage they do to their children which shall come after them."

It requires no wondrous flight of the imagination to picture the physical condition of the United States in the next century, when the forests shall have been stripped from the granite hills of New England, from the Adirondacks, the Alleghanies, the far-reaching wooded borders of the Great Lakes, and the region east of the Mississippi. Then, if the people of the prairies west of the Missouri have been diligent in profiting by the examples of history, and have listened to the teachings of nature, let us imagine ourselves, with enlarged vision, standing upon one of the exalted peaks of the Snowy range, and describe the panorama spread out before us: Far beyond, like a gleam of sunshine, separating the continent into two widely diversified regions, flows the mighty Mississippi, the only river of its kind in the world. On its bosom is freighted to the ocean the products of the different latitudes through which it winds its majestic course. On either side are aggregated the vast manufacturing interests of the wonderful empire grown up in its fertile valley. The materials for the evolution, through the medium of mechanical genius into the forge and the loom, are transported to the vast continents of workshops by a magnificent network of railroads. In the old States, an impoverished soil induced by their denudation of timber, has reduced their once boasted productiveness to zero, while intense drouths, deluging storms and fitful variations of temperature mark the meteorological conditions of their whole area. That once fertile region has been rendered almost uninhabitable through the wantonness of man, and its former proud civilization transferred to the prairies beyond the Missouri. The "Great American Desert," depicted so graphically in the geographies of the last generation, has disappeared, and in its place is presented a system of agriculture such as the world scarcely ever dreamed of—marvelous in its results and grand in its diversity.

SCIENTIFIC MISCELLANY.

THE USES OF ARTIFICIAL STONE.

BY HENRY REED, C. E.

Building with concrete materials has been practiced in every age; but the Romans gave the greatest consideration to the subject and they constructed subaqueous works by that system thousands of years ago. Their name for a mixture of hydraulic mortar and broken stones was *signinum*, and with that preparation they constructed various piers and harbors on the shores of the Mediterranean Sea. Subsequently they added pozzuolana, which imparted increased setting energy to the comparatively inert lime, with the advantage of improved hydraulicity. French engineers in modern times adopted a similar system; but in England, from a variety of causes, the matter has not received that attention which its importance deserves.

A difference of opinion exists as to the difference between *beton* and concrete; and some writers endeavor to draw a distinction between the two, regarding *beton* as being made with hydraulic mortar and concrete prepared from non-hydraulic limes. Others again consider the difference to be in the mode of mixture; when the cement or lime is first mixed with sand, before being incorporated with gravel, it is termed *beton*, and when that preliminary operation is omitted it is called concrete. Such distinctions are too nice for practical purposes, and are alluded to only for the purpose of avoiding confusion in the use of the two terms. The names *beton* and concrete may therefore be considered synonomous, as indeed their names imply; and we may regard the term concrete as generic, embracing all mixtures of whatever description used for building purposes. English cob, Irish dab, and their several varieties, as well as Spanish *tapia* and Italian *pisa*, may be termed concrete, for they are respectively amalgamations of several materials.

General Pasley has assigned the merit of introducing concrete in England to Sir Robert Smirke, who used it on an extensive scale in the foundations of Millbank Penitentiary; and in his work on cements relates the accidental circumstances which led that eminent architect to the adoption of the preparation. It is immaterial to us who was the inventor or adapter of one kind or other of the different varieties of concrete, although we may be justified in ascribing it to an origin of great antiquity. The use of conglomorate masses of clay only, or in combination with other materials, continued through many ages of the world's history until the discovery of iron working, when man was enabled by its agency to adapt and shape stone to the required forms. Subsequent chemical knowledge led to the use of cementitious materials for connecting or binding stones; and clay, bitumen, sulphates and carbonates of limes, and pozzuolanas were severally used for

that purpose. Advancing engineering and chemical science, conjunctively experimenting on the varied properties of limes and cements, have succeeded in the introduction of a cement possessing the valuable qualities of moderately quick setting and permanent induration.

Vicat, Pasley and other practical investigators have ably assisted in this consumation by their painstaking and laborious researches on limes and artificial cements. Smeaton, however, in his experiments to ascertain the most suitable mortar with which to construct the Eddystone Lighthouse, initiated the method which eventually resulted in the discovery of Portland cement. Although lime in combination with pozzuolana or other volcanic products had been, from the time of Vitruvius, used to resist the injurious action of water, their beneficial conjunction was not satisfactorily explained until the time of the Eddystone experiments. Modern experience has somewhat modified Smeaton's conclusions, but, nevertheless, we may consider ourselves much indebted to him for a knowledge of hydraulic limes and the causes of their hydraulicity.

Architects, profiting by engineering experience, now look upon concrete with more favor, and begin also to appreciate its merits. Facility of executing the most detailed ornamentation in Portland cement, mortar or concrete, will ultimately secure its general adoption. In Germany great attention is bestowed on the preparation of a variety of articles in connection with building; and machinery of various kinds is used for molding and shaping architectural details which in this country are performed by the expensive agency of the plasterer or stone carver. Pipes for sanitary purposes are made by machine, and for many reasons are most suitable for the conveyance of sewerage. Many miles of sewers under the city of Paris have been constructed of *betons agglomeres*, a kind of concrete possessing many valuable peculiarities.

The several advantages secured in the construction of houses with concrete, and the facility with which the materials of almost every locality may be adapted for the purpose, is not the least important one. Improved means of resisting the climatic influences of our changeable atmosphere are commanded by the use of concrete walls, and numerous sanitary improvements are secured by its application. Its progressive hardening properties enable it to resist effectually the damaging influence of frost in the severest climates. Deleterious ingredients of the most vitiated atmosphere fail to disintregrate or otherwise damage it. The comparatively non-absorbent character of Portland cement and the improvement which it effects on any material with which it may be united, secure the maximum amount of comfort to the inmates of a house so constructed.

General Gilmore says: "Another interesting application of this material has been made in the construction, completed or very nearly so, of the light-house at Port Said, Egypt. It will be one hundred and eighty feet high, without joints, and resting upon a monolithic block of *beton*, containing nearly four hundred cubic yards. In design it is an exact copy of the Baleines light-house, executed after the plans and under the orders of M. Leonce-Regnaud, engineer-in-chief.

An entire Gothic church, with its foundations, walls and steeple, in a single

piece, has been built of this material, at Vesinet, near Paris. The steeple is one hundred and thirty feet high, and shows no cracks or other evidences of weakness.

M. Pallu, the founder, certifies that "during the two years consumed by M. Coignet in the building of this church, the *beton agglomere*, in all its stages, was exposed to rain and frost; and that it has perfectly resisted all variations of temperature."

The entire floor of the church is paved with the same material in a variety of beautiful designs, and with an agreeable contrast of colors.

In constructing the municipal barracks of Notre Dame, Paris, the arched ceilings of the cellars were made of this *beton*, each arch being a single mass. The spans varied from twenty-two to twenty-five feet, the rise, in all cases, being one-tenth the span, and the thickness at the crown 8.66 inches. In the same building the arched ceilings of the three stories of galleries, one above the other, facing the interior, and all the subterranean drainage, comprising nearly six hundred yards of sewers, are also monoliths of *beton*.

One of these vault arches, having a span of 17½ feet, was subjected to severe three trial tests, viz:

First. A pyramid of stone work weighing thirty-six tons of two thousand pounds each, was placed on the center of the vault.

Second. A mass of sand thirteen feet thick was spread over the surface of the same vault.

Third. Carts loaded with heavy materials were driven over it.

In no instance was the slightest effect produced.

A portion of the basement work of the Paris Exposition building comprised a system of groined arches, supported by columns about 13¾ inches square and 10 feet apart. The arches have a uniform rise of one-tenth the span, and a thickness at the crown of 5½ inches, are monoliths of *beton agglomere*. A system of flat cylindrical arches of ten feet span, covers the ventilating passages. They have a rise of one-tenth, and a thickness at the crown of not quite 8 inches, and were tested with a distributed weight of 3,300 pounds to the superficial yard.

There was consumed in the construction of this basement work more than 353,000 cubic feet of *beton*.

Over thirty-one miles of the Paris sewers had been laid in this material prior to June, 1869, at a saving of 20 per cent. on their lowest estimated cost, in any other kind of masonry.

Several large city houses, some for places of residence, and others for business purposes, have been constructed, and many others are in contemplation. In these the entire masonry, comprising both the exterior and the partition walls, the chimneys with flues, cellar arches, cisterns, etc., is a single monolith of *beton agglomere*.

It may be advantageously used in fortifications, for foundations, generally, both in and out of water; for the piers, arches, and roof surfaces of casemates; for parade and breast-height walls; for counterscarp walls and galleries; for scarp

walls, except those that shield guns; for service and storage magazines; for pavements of magazines, casemates, galleries, etc., and generally for all masonry not exposed to the direct impact of an enemy's shot and shell."

OPTICAL EFFECTS OF INTENSE HEAT AND LIGHT.

BY JOSHUA THORNE, M. D.

The following facts have lately come under my observation at the rolling mills at this place:

While looking at the eclipse of the sun July 29th, I handed the glass to one of the mill "heaters." He at once told me he could see as well with the naked eye as with the smoked glass. I then tried another "heater," and he at once repeated the same statement. I then went to the rolling mill and tested every "heater" at his furnace. They all told the same story. I hunted up every "heater" in the town except two (who were not found), over twenty in all, and everyone declared he could see the phenomenon, and all its phases, as well or better with the eye unshaded. I took the precaution to test each one by himself, told him nothing of what I expected, or of the testimony of others. I made no suggestions to any of them, but let each tell his own story. All told the same tale; one peculiarity all agreed to, the image in the glass was upside down from what they saw with the naked eye. They would describe many peculiarities of color which could not be seen by others with the aid of the glass. It should be remembered that the "heater" has to see his iron in the furnace while it is enveloped in a flame whose intense glare prevents unskilled eyes from seeing anything, an education of the eye peculiar to this class of workers, as no other class of workmen is exposed to the same degree of heat or light.

I noticed as soon as the eclipse had progressed some time that I became nervous. I observed the same fact in many others about me. My wife at home did not think of the phenomenon at first, but became so nervous that she had to rush out of doors; she then saw the eclipse for the first time. I found this nervousness more in women than among men, chiefly in persons of debilitated frame, such as convalescents. Is this magnetic?

In accordance with your request, I repeated the experiment of Ericsson, and submitted a spherical piece of iron, eight inches in diameter, to a heat of over 3,000 degrees, Fahr. It was carried to an almost melting point, withdrawn from the flame and placed on a stand. It had the appearance of a disc at all distances tried, up to over 100 feet. As seen by Mr. Hughes, the chief engineer of the mill (one of the most scientific men in his line in the West), myself and others, it was perfectly *flat*. The convexity did not appear; it was while in this state, to all appearance no longer a *sphere*, but a *disc*. As the iron cooled off it resumed its original appearance of a sphere. Our mill men were much surprised by this phenomenon which they had been seeing all their lives, but till now had never observed.

ROSEDALE, Aug. 12, 1878.

DENSITY OF POPULATION AND HEALTH.

At a general conference of British architects, a few weeks ago, the general building regulations of the United Kingdom were discussed at length. Among the points brought out were these: 1. That the experience of what are called model lodging houses, such as the Peabody buildings in London and other large towns, combined with that of barracks, workhouses, and schools, furnishes abundant evidence that what is termed density of population is not so detrimental physically as has been hastily assumed; because in such buildings as are referred to the rate of mortality is much less, with a density of 1,500 persons to the acre, than it is in ordinary small houses, with a density of only 250 to the acre. 2. That the health of a community is much more dependent upon food, clothing and personal habits than upon the arrangement and construction of dwellings or workshops; for however perfect may be the arrangement and construction, they may be entirely neutralized if the food is bad, the clothing deficient, and the personal habits filthy.

The unsanitary conditions of densely populated districts in this city seems to be chiefly due to the fact that the houses of the inhabitants were not originally intended for those who have come to live in them.—*Scientific American.*

BOOK NOTICES.

A Course in Arithmetic. A treatise in three parts, complete in one volume. By F. W. Bardwell, Professor of Astronomy in the University of Kansas. 12 mo.; pp. 154. G. P. Putnam's Sons, New York. For sale by M. H. Dickinson, $1.25.

The necessity for a new treatise on Arithmetic, and the advantages of this treatise over some others, are pointed out by Professor Bardwell so modestly, and at the same time so clearly, that we cannot do better than quote his own language: "First, it is intended to present, in the compass of a single volume, a complete treatise, and, indeed, all that the average pupil needs to study on the subject from first to last. Secondly, the subject matter is arranged in three parts, logically distinct, in each of which the pupil gives his attention to a specific object complete in itself. The first part comprises the simple operations; the second, an explanation of the various measures in use, including the metric system; the third, the various applications of numerical computation to practical questions. A third marked feature is found in the character of the definitions and of the expositions of principles. The treatment of each topic is lucid and logical, and, at the same time, in harmony with rigorous scientific accuracy." One point, in which we especially agree with the author, with whom "the conviction has been reached only with deliberation and after long experience and observation," is that much time has been wasted in so-called Arithmetical drill, i. e., in "mental" or "intellectual" exercises. A practical improvement that we notice as peculiar to Professor Bardwell, is giving the definitions and rules in the

shape of a "Review" after each chapter of demonstrations and principles. This, to our notion, is the natural and proper order and one which is just the reverse of the method of the arithmeticians of our school-days.

This Course is unusually full, extending from numeration to mensuration, and closing with tables of Insurance, compound interest, miscellaneous estimates, etc. The work is comprehensive, practical and of logical arrangement and will doubtless become popular wherever introduced.

Annual Record of Science and Industry for 1877. Edited by Spencer F. Baird, with the assistance of eminent men of science. New York, Harper & Brothers, 1878. For sale by M. H. Dickinson, successor to Matt. Foster & Co., $2.00

This familiar visitor, the seventh of the present series and the twenty-seventh of a series commenced in 1850 and known as the Annual of Scientific Discovery, made its appearance upon our table several weeks since; too late, however, for notice in the July Review. Professor Baird has somewhat changed the plan of the work as heretofore published, by summarizing the work done by societies and individuals instead of giving abstracts of important papers, reports, &c. This has been rendered absolutely necessary to avoid extending the size of the volume beyond bounds; otherwise, it would to us seem an objectionable change.

The subject of Astronomy has been worked up and arranged by Professor Holden, of the United States Naval Observatory; that of Physics of the Globe, by Professor Cleveland Abbe, of the Weather Bureau; those of Physics and Chemistry, by Professor George F. Barker, of the University of Pennsylvania; that of Mineralogy, by Professor Edward S. Dana, of Yale College; that of Geology, by Professor T. Sterry Hunt, of the Institute of Technology, Boston; those of Geography and Hydrogaphy, by Lieutenant-Commander F. M. Green, U. S. N.; that of the Geography of North America, by Professor S. H. Scudder, of Cambridge, Massachusetts; Microscopy, by Professor Hamilton L. Smith, Hobart College; Anthropology, by Professor Otis T. Mason, Columbian University; Zoölogy, by Professor A. S. Packard, Jr., Peabody Academy of Science; Botany, by Professor W. G. Farlow, Harvard College; Agriculture and Rural Economy, by Professor W. O. Atwater, Wesleyan University; Engineering, Technology and Industrial Statistics, by Professor W. H. Wahl, Philadelphia, Pennsylvania; Bibliography, by Professor Theo. Gill, of the Smithsonian Institute. All of these gentlemen stand at the head of their respective departments and their work can be relied upon as accurate, comprehensive and brought down to the most recent dates. In many respects this volume is superior to any of its predecessors, and the series has no equal in the scientific world for completeness, whether in design or execution.

Manual of the Vertebrates of the Northern United States.—By David Starr Jordan, Ph. D., M. D., Professor of Natural History in Butler Uni-

versity. Chicago, Jansen, McClurg & Co., 1878, large 12 mo., pp. 407. Sold by H. H. Shepard. Price, $2.50.

We spoke of this valuable work somewhat extendedly a few months since in the Review, but having since then received a complete copy from the publishers, we have examined it thoroughly and find it all that the advance sheets, sent us at that time, promised.

The Manual of 1876 has been thoroughly revised and much of it re-written, especially that portion pertaining to the fishes, including descriptions of all the American salmon and trout, with their habits and technical names, which feature ought to commend the book to sportsmen as well as scientists. In every class, order and family the descriptions are brief but clear, while all of the lately discovered species are taken account of in their proper places. Such works are of the greatest value to the general reader, and frequently to editors as books of ready reference. We have placed this volume in our hand rack along with Orton's Comparative Zoology, Buckley's History of Natural Science, Rodwell's Dictionary of Science, Wagner's Technology, the Annual Record of Science and Industry, etc.

How She Came into Her Kingdom. A Romance.—By Mrs. Charlotte M. Clark. Jansen, McClurg & Co., 1878, 12 mo., pp. 337. For sale by H. H. Shepard. Price $1.50.

It is difficult to give an idea of this remarkable book in the few lines we can spare to it. Suffice it to say, that Mrs. Clark has a vivid imagination and excellent descriptive powers, which, with her manifestly excellent education and training in physical matters, will, when properly toned down, make her one of the most popular writers of the day.

The plot of the book is decidedly original and combines many bold and startling scenes and effects, which culminate in the coming of the heroine "into her kingdom" through great tribulation and many trials. It is richly worth perusal and no one who commences it will lay it down unread.

The Primer of Political Economy.—By Alfred B. Mason and John J. Lalor. Chicago, Jansen, McClurg & Co., pp. 67. For sale by H. H. Shepard. Price 75 cts.

This is an attempt by the authors to give the principles of Political Economy in sixteen definitions and forty propositions, and it is so far successful that many of our latter-day statesmen would be largely benefited by a careful study of them. It is intended, the authors say, for use as a text book in the schools, and as such, doubtless, will be of great service, being the result of much study and research on the part of the authors, and written in a simple and attractive style.

Catalogue of the Missouri University at Columbia, Mo., 1877–1878.—Jefferson City, Regan & Carter, octavo, pp. 136.

The University of Missouri was founded by a grant of some 40,000 acres of land to the state for that purpose in 1820, but was not located until 1839, when

the commissioners appointed for the purpose unanimously selected Columbia as the site. In 1862 a munificent land grant for agricultural colleges was made by Act of Congress, which largely increased the endowment of the University, so that it is now freed from all pecuniary embarassments.

The different departments of the University are the Academic schools, at which the sciences and languages are taught, and the Professional schools, at which Agriculture, pedagogics, law, medicine, mining and metallurgy, engineering and art are taught by capable and distinguished professors, aided by the most modern instruments and other appliances. Very few persons have an idea of the extent and importance of our State University, and it would, doubtless, surprise and gratify a large majority of our citizens to examine this catalogue.

EDITORIAL NOTES.

The American Association for the Advancement of Science opens its twenty-seventh annual meeting at St. Louis, on the 21st inst., with rendezvous at the Lindell Hotel, after which the general sessions will be held at Armory Hall.

The offlcers of the Association are as follows:

President, Prof. O. C. Marsh, of New Haven; General Secretary, Prof. H. Carrington Bolton, of Hartford; Permanent Secretary, Prof. F. W. Putnam, of Cambridge; Vice President section A., Prof. R. H. Thurston: Vice President section B., Prof. A. R. Grote; Secretary section A., Prof. F. E. Nipher, St. Louis, Mo.; Secretary section B., Prof. Geo. Little, Atlanta; Treasurer, W. S. Vaux, Philadelphia, Pa.; Chairman of Permanent Subsection of Microscopy, Prof. Geo. S. Blackie, Nashville; Chairman of Permanent Subsection of Chemistry, Prof. F. W. Clarke, of the University of Cincinnati, Ohio.

The indications are that this meeting will be very largely attended by the most prominent scientists of this country and Europe, and the people of St. Louis are making special preparations to entertain them.

A special invitation has been extended to the foreign scientists, Norman Lockyer and Prof. Janssen to attend the meeting, and the invitation will undoubtedly be honored. Thos. Bell, F. G. S., of London, England, is also coming. Prof. Simon Newcomb, of the the Naval Observatory, Washington, Dr. Asaph Hall, the discoverer of the satellites of Mars, Prof. J. A. Rogers, Prof. Wm. Harkness, Alvan Clark, the greatest manufacturer of astronomical lenses of any age, Prof. J. R. Eastman, H. S. Pritchett, of Glasgow, Mo., Prof. E. S. Holden, Dr. C. S. Hastings, L. Trouvellot, G. W. Hill, of the Nautical Almanac, Ormond Stone, of Cincinnati, Gen. Meyer and Prof. Abbe, of the Signal Service, Prof. Langley, of Alleghany Observatory, G. F. Baker, of Philadelphia, Dr. Bolton, of Hartford, Conn., General Secretary of the Association, Prof. F. W. Putnam, of Cambridge, Mass., its Permanent Secretary, Dr. Goodale, of Harvard, Prof. Ricketts, of Columbia College, Thomas Mehan, of Germantown, Pa., H. C. Lewis, Thos. Bassnett, of Florida, P. W. and W. S. Sheafer, of Pottsville, Pa., Oliver M. Bryant, of Accokeek, Md., J. H. Kellogg, of Battle Creek, Mich., R. W. Thurston, of Hoboken, A. P. S. Stuart, of Lincoln, Neb., S. A. Latimer, of Rochester (N. Y.) University: President O. C. Marsh, of New Haven, Benjamin Pierce, of Cambridge, Jas. D. Dana, of New Haven, Jas. Hall, of Albany, Isaac Lee, of Philadelphia, T. A. P. Barnard, President of "Columbia," Stephen Alexander, B. A. Gould, Thomas Sterry Hunt, all of Boston, Prof. Asa

Gray, of Cambridge, J. L. Smith, of Louisville, J. S. Lovering, of Cambridge, John L. Leconte, of Philadelphia, Prof. J. E. Hilgard and W. H. Dall, of the Coast Survey, S. A. Goldschmidt, the eminent young chemist from New York, and Prof. C. A. Young, besides a number of ladies of scientific attainments. Prof. J. K. Rees, of Washington University, St. Louis, is the local Secretary, to whom all inquiries should be addressed.

As long ago as 1855, Professor G. C. Swallow, then State Geologist of Missouri, declared in his official reports and otherwise, that this portion of the state, and also Eastern Kansas and Southeastern Nebraska, were all underlaid with coal. He also pointed out the existence of the immense deposits of lead and zinc which have since been discovered in Southwest Missouri and Southeast Kansas. The long-worked vein of coal at Leavenworth and the newly.discovered one at Rosedale, now also testify to the correctness of Professor Swallow's statements and the remarkable accuracy of his geological knowledge.

THE following items in regard to the eclipses of the sun and moon as observed at this city are furnished by Mr. W. W. Alexander, Optician, No. 9 East 7th street:

The observed time of the Solar eclipse of July 29, 1878, was as follows, Kansas City mean solar time: First contact, 3 hours 12 minutes 34 seconds, p. m.; last contact, 5 hours 18 minutes 13 seconds; duration from first to last contact, 2 hours 5 minutes 39 seconds; magnitude about 10 digits, or $\frac{5}{6}$ of sun's diameter.

The Lunar eclipse of August 12, 1878, last contact (alone observed here) with earth's umbra, or darkest shadow, 7 hours 17 minutes 23 seconds. p. m., Kansas City mean solar time. Duration from moon rise about 27 minutes.

OF the September monthlies only *Harper's* and the *Atlantic* have as yet made their appearance. Both are excellent numbers, containing essays, stories and poems at least up to the usual high standard of these magazines.

THE RAIN-FALL at Kansas City, for the past twelve months, as recorded and reported to the Signal Officer at Washington was as follows:

August, 1877,	rain	fell 2	days	to amt.	of	1.54	ins.
September. 1877,	"	" 6	"	"	"	3.66	"
October, 1877,	"	" 9	"	"	"	6.96	"
November, 1877,	"	" 8	"	"	"	2.50	"
December, 1877,	"	" 13	"	"	"	2.60	"
January, 1878,	"	" 10	"	"	"	1.27	"
February, 1878,	"	" 8	"	"	"	1.96	"
March, 1878,	"	" 14	"	"	"	3.45	"
April, 1878,	"	" 10	"	"	"	2.70	"
May, 1878,	"	" 15	"	"	"	4.51	"
June, 1878,	"	" 16	"	"	"	2.62	"
July, 1878,	"	" 10	"	"	"	2.20	"
Twelve months,	"	" 121	"	"	"	35.97	"

There were but four snow storms during the winter in which snow fell enough to be measured, the total fall for the season being just seven inches.

THE following items are taken from the daily bulletin of the Signal Office:

LOCALITY.	Highest.	Lowest.	Mean.
San Francisco, Cal.	71°	60°	64.3°
Sacramento, "	94	81	88.5
Denver, Col.	97	72	85
Kansas City, Mo.	95	75	87
St. Louis, "	96	76	87

Observations taken at about 3:30 p. m. each day for ten days, from August 3 to 12, inclusive.

The greatest change of temperature in twenty-four hours occurred at Dodge City, Kansas, and Denver, Colorado: at the former the thermometer indicated twenty-seven degrees less at 3:30 p. m. on the 10th than on the previous day at the same hour, and at Denver twenty-three degrees less on the 9th.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. SEPTEMBER, 1878. NO. 6.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

27TH ANNUAL MEETING AT ST. LOUIS, MO.

On Wednesday, August 21st, this distinguished body of American scientists met in the chapel of the University of St. Louis, at 10 A. M. Prof. Simon Newcomb, late President, opened the exercises by introducing Prof. O. C. Marsh, of New Haven, the newly elected President, who assumed the position with a few appropriate remarks. Professor H. C. Bolton, General Secretary, (to whom and to the *Globe-Democrat* we are indebted for the material for this report) and Professor F. W. Putnam, Permanent Secretary, occupied their proper places and announced the order of exercises and the arrangements made by the proper committees.

After addresses of welcome by the Mayor of St. Louis and Professor W. T. Harris, of the St. Louis Academy of Science, which were responded to by President Marsh, the regular business of the Association was commenced.

The Secretary read the following list of members deceased since the date of the last meeting: Abram Sager, of the University of Michigan; Ezra Read, of Terre Haute, Indiana; Joseph Henry, of Washington D. C., who was an original member of the Association, and President of the second meeting, held in Cambridge, Mass. in 1849, and had always taken an active interest in the Association; C F. Hartt, of Cornell University; James Swain, of Fort Dodge, Iowa; G. W. Keely, of Waterville, Me:, died in 1878, an original member of the Association; John V. L. Pruyn, of Albany, N. Y., an original member of the Asso-

ciation; James Bowron, of South Pittsburg, Tenn.; Wm. Monroe, of Concord, Mass.; John W. Armstrong, D. D., of Fredonia, N. Y.; Ebenezer S. Snell, of Amherst, Mass., died in 1877, who joined the Association at its second meeting; F. W. Bardwell, Professor of Astronomy in the University of Kansas, Lawrence, Kansas.

The following named gentlemen were elected members of the Standing Committee: A. G. Weatherby, C. V. Riley, F. W. Clarke, George Engelman, J. W. Osborne and A. H. Worthen.

Messrs. R. H. Ward, Simon Newcomb and H. C. Bolton were elected members of the Committee of Section A—Mathematics, Astronomy, Physics, Chemistry and Mineralogy.

Messrs. Morgan, Safford and Latimore were elected members of the Sectional Committee of Section B—Geology, Zoology, Botany and Anthropology.

The Entomological Section, which commenced its sessions the day before and listened to several interesting papers by Miss Emily Smith, of Peoria, Ill., and Prof. Riley, of this State, held an afternoon session at the Lindell Hotel, at which Dr. J. Lintner, President, of Albany, N. Y., discoursed briefly on the methods of collecting *Lepidoptera*.

Miss Emily Smith spoke on the natural history of *Argyrolepia quercifoliana L.*, an insect whose larva in 1877 devastated the oak forests of Wisconsin and Illinois, leaving the trees bare of leaves as if winter had come.

A very interesting discussion came up on the question of instinct (or reason?) displayed by some insects. Miss Smith cited the case of *Pimpla conquisitor*, a parasite on bark lice, that deposits its egg in the ova-producing females only—a curious case of instinctive selection. Mr. Wetherby cited a case of instinct at fault displayed by the larva of *Platysamia cecropia*, confined in a glass, and President Lintner spoke of a *Prometheus* larva that lashed two twigs together in order that it might not be prevented by the breeze from spinning its cocoon.

There was a little informal discussion as to the visual powers of spiders, and then the Section adjourned until the next annual meeting.

The evening session was held as before, in the chapel of the University, and the first paper read was entitled

THE PHILOSOPHIC METHOD OF THE ADVANCEMENT OF SCIENCE.

BY PROF. R. H. THURSTON, HOBOKEN, N. J.

LADIES AND GENTLEMEN: I have chosen for my subject on this occasion one which is, in my opinion, peculiarly suited for the annual address of a Vice President of the American Association for the advancement of Science—a subject which may appear a novel one to many among those to whom it is presented, but one which will, I hope, prove none the less interesting for that fact. I propose to indicate the existence of a "Science of the Advancement of Science," exhibiting some of the facts upon which it is based, enunciating some of the laws and the principles of that science, and thus, as well as I may, presenting its philosophy.

I propose to show, as concisely as possible, where and when this philosophy had its origin and what has been its method of growth. I desire to show what should to-day be done for this science, to indicate what seem to me the best methods, and what system is likely most effectively to facilitate its progress.

Science—which has been defined by Fleming as "knowledge, certain and evident in itself, or by the principles from which it is deduced or with which it is certainly connected"—consists of two parts. As Sir William Hamilton has stated it, science is a "complement of cognitions, having in point of form the character of logical perfection, and in point of matter the character of real truth." While it is the foundation of all art, it is itself founded upon a precise and sure knowledge of certain of the great facts of nature and upon man's power of detecting and of revealing the great truths which have been established by the Creator of the universe. The two parts are the pearls of truth which man has thus been able to gather and the chain of laws and principles upon which those facts are strung and by which they are firmly connected as the pearls of a lady's necklace are bound together by the silver thread or the golden wire which gives the precious treasure its continuity. The basis of all science is the mass of facts which make up the universe of the known and the to-be-known, and its existence depends upon and is assured by the immutability of the laws of nature and of all those principles of philosophy which are woven into the connecting chain.

The man of science, the philosopher, whose task it is to create and to advance human knowledge of the great kingdom of nature, is, therefore, a discoverer of facts, an observer of phenomena, a student of the laws of nature and a codifier of those laws, as well as a systematic recorder of facts. He gathers the pearls of truth and collects the silken threads that we term principles, spins them into the cords, works them into the chains upon which he strings his pearls, and thus a science is formed. Thus, centuries before the commencement of the Christian era the Chaldean astrologers were studying the motions of the sun, the planets and the stars, and recording their observations for the benefit of those who, in modern times, have been glad to fit those facts to lately discovered law; thus, Kepler, month after month and year after year, assuming one mathematical law after another to be applicable to the relation of periodic times to the distances of the circling planets from their central sun, tried to fit already discovered pearls of fact to his various threads of principles, and, after nineteen years of persevering labor, found the right string at last, and proclaimed the great law which Newton then fitted to other facts, and, taking another great step, this greater philosopher showed to all men the world-wide prevalence of the law of gravitation. Thus, again, those great astronomers and mathematicians, Leverrier and Adams, seizing upon the great fact of the indefinite application of Newton's law of gravitation, proved the other till then unknown fact of the existence of a mighty world, far beyond the then recognized boundary of the solar system, and told observers just where to point their telescopes to bring the previously unseen planet into view.

But, although scientific work has been in progress during so many centuries, it was only in the time of Galileo, and when, two centuries ago, his contemporary,

"Bacon, at last a mighty man, arose,
Whom a wise King and nation chose
Lord Chancellor to both their laws,"

and when the experimental philosophy of the first and the system of inductive philosophy of the second united to form a perfect whole—it was only then tha the existing system of philosophy had a beginning.

The peripatetic philosopher had, two thousand years before, adopted the so-called modern system in his teachings. Aristotle may, therefore, be with greater propriety called the father of that inductive philosophy of which Bacon was the first modern expounder, and of which Galileo was the first of modern disciples—the first of systematic experimentalists. It was only after this system of true philosophy had become accepted by learned men that it became possible for the various branches of modern science to take shape. It was only then that the discoveries of Galvani, the inventions of Volta and of Von Guericke, and the facts recorded by Gilbert, the investigations of Oersted and of Franklin, and the researches of the multitude of their illustrious successors in the present generation, could give form to the now well-developed department of electrical science, It was only after this time that the application of quantitative methods of analysis by Lavoisier, the greatest of chemists, could enable his confreres and his successors to combine the facts recited by the alchemists of earlier times, the discoveries of Priestly and Scheele and of Cavendish and of the later chemists, with the laws enunciated by Boyle and Dalton and Avogadro and others, could only then contrive to form a system of chemical philosophy, which, still avowedly crude, is nevertheless one of the most magnificent of all physical sciences. It was only after the inductive method had become recognized as the only effective method of acquiring a knowledge of the phenomena and the laws of nature, that mathematical sciences—originating as they did in an unknown antiquity, and given form by Euclid and Diophantus, by the Romans, the Greeks and the Arabians centuries ago, and perfected in later times by Descartes, Newton and Leibnitz—became applicable to the investigations by the natural philosophers in every branch of their magnificent work.

The richest fruits of this great system are familiar to all, and have nearly all been developed within the memory of many to whom these words are addressed. The facts revealed by the researches of Rumford, Davy and Joule have been grouped and systematically united by the laws revealed by Rankine, Thompson, Clausius and other hardly less eminent men, and the science of thermodynamics which has been thus created has been applied and put to the proof by Hirn and a hundred other distinguished engineers of our own time. Finally, it is only now that it is evident that this last is but another branch of the universal science of energetics which controls all effective forces in all departments of science. The man is still to come forward who is to combine all facts comprehended by this latest science into one consistent whole, and to illustrate its application in all methods of exhibition of kinetic energy.

The grand principle which we are just beginning to admit and recognize as

underlying every branch of knowledge and as forming the foundation of all the sciences—of all science—seems, when stated, to be simply an axiom. The Scriptural declaration that the universe shall endure forever is but a statement of the principle which is now becoming more and more generally admitted as a scientific truth, viz: That the two products of creation, matter and force and the fruit of their union—energy—are indestructible.

The grand underlying basis of all science is found, then, in this principle: All that has been created by Infinite power—matter and its attribute, force, and all energy—is indestructible by finite power, and shall continue to exist as long as the hand of the Creator is withheld from their destruction. This law has been admitted almost from the time of Lavoisier, so far as it affects matter; it has been admitted as applicable to energy since the doctrines of the correlation of forces and the persistence of energy became acknowledged by men of science, and we are gradually and rapidly progressing toward the scientific establishment of the law of persistence of all existence, whether of matter, force and energy or of organic vitality, and perhaps even of soul-life. The truths of science are thus coming into evident accord with those doctrines of religious belief which underlie every creed. We are, however, apparently as far as ever from the determination of the question whether the higher forms of force and energy have quantivalent relations and intertransformability, notwithstanding the fact that a belief in the identity of mind and matter and that in matter can be discerned "the promise and potency of all terrestrial life" has been avowed, explicitly or implicitly by more than one great thinker, who has wandered into the realms of speculation.

Looking back to the beginning, we see, then, that in the beginning there entered upon an existence which is of indefinite duration a great universe of matter endowed with its characteristic attributes—the forces of nature. These forces acting upon all matter gave birth to a fixed amount of actual energy, and are capable of producing another fixed quantity of what is now potential energy. Energy thus coming into existence remains constant in amount as the quantity of created matter remains constant.

The action of these forces upon this matter has given rise to every phenomenon which has come or does now come within the range of scientific inquiry. But all known forces are seen at once to be capable of classification, according to their methods of affecting matter, into three great classes:

(1.) These forces with which we are able to make ourselves so thoroughly familiar that we find no difficulty in assigning to each of them its proper place in the scheme of scientific systemization, and which we have found it comparatively easy to distinguish by their peculiar and readily observed effects. These comprehend the familiar physical forces, as gravitation, electricity, chemical affiinity and mechanical forces.

(2.) The vital forces—those which are necessary to the preservation of all life, which produce and promote the growth of all organisms having life, and which are less readily comprehended, more difficult of study, and far less subject to the modifying power of man than are those of the first-named class.

(3.) The forces of the soul and of the intellect—those most wonderful and mysterious of all known forms of force; forces of the nature of which we know nothing, and of the effects of which, actual and possible, we have the least comprehension.

(4.) That great master-force, Omnipotence, which is the source and sustainer of all forces and of all existences.

By the study of the universe as it now exists, philosophers are led to perceive that its present state is such as it would have been had these various forms of matter with which we are surrounded, and of which we are ourselves corporeally composed, and other existences which we suspect to form a part of our universe, seen at the beginning, so distributed by the Creator and so placed in reference to the several kinds of forces that the former, acted freely upon by the latter, should take all the infinite variety of shape and all that inconceivable variety of growth that has by the wonderful process called evolution been brought into the history of the universe; and they are still continuing to illustrate the mighty and incomprehensible power of Him who is the Author of all things. It is seen that, under the action of these forces upon this matter, a universe is forming out of chaos, that all its parts are exhibiting the wondrous power and the marvelous intricacy of His scheme, and the yet more wonderful simplicity of the means by which He is accomplishing His purposes.

Studying the universe as far as we may in detail, we see that each of the various forms of force which has been set at work to modify the position and the character of matter has a special part to perform, and that the first class has a sphere of operation which is fully within the reach of our senses; that the second class of forces is also, to a certain extent, familiar to us through a knowledge of their effects; but that of the last two of the several classes of forces existing in nature we are entirely unprepared to treat. We are too utterly ignorant of them to do more than speculate, and our speculations are not more likely to find any directly profitable result than those of our Greek predecessors in that "unknowable" field- There is no beginning, even in a true moral and intellectual science. We have found no quantitative measures of those forces or of their effects, and no definite principles are known which control their action. They must probably be left for the consideration of those who follow us.

The last named—Omnipotence—is beyond the imagination even, but, studying these forms of the manifestation of force which are divided between the first two classes just mentioned, we at once perceive a distinction which is as well defined as the line of demarcation between the two classes of phenomena to which they give rise.

The physical forces—and I intend here to include the mechanical and chemical as well as the forces which are usually alone treated of in works on physics—are capable of being detected, of being distinguished by certain readily defined qualities and of being accurately determined by quantitative measurement. The conditions which lead to their active exertion are capable of being ascertained, and the precise results of their action under a given set of conditions may be us

ually predicted. These conditions are capable of certain definite modifications by the power of man, and the changes of effect which will result from such changes of condition are predicable. Those effects which nature is accustomed to produce in certain cases by the action of these forces may be modified by man without entirely defeating the force in its effort to produce a given change of mode of existing energy. These forces, acting alone, never give rise to the more intricate forms seen in nature. Their highest product in the whole morphological catalogue is a crystal of more or less perfect shape, but of a form which is always of some simple geometrical class. These forces rarely exhibit the play of definitely directed energy tending to effect a perfectly definite but remote effect. These effects are the accidental and the incidental, so far as the more wonderful and intricate of the operations of nature are concerned.

The vital forces, on the other hand, effect operations which human power cannot touch except to impede and to destroy. They have for their mission the creation of strangely intricate and curiously organized structures in which are stored certain definite amounts of energy, and which are given a power of acquiring and of applying extraneous energy, in probably definite amount, to the accomplishment of certain kinds of tasks. Man may modify their operation and may produce some change in the effects which they are appointed to bring about; but it is only by deranging their action. He can never directly assist them. That store of vital energy which was created in the infinite past and which is now passing into one after another of the new forms of life which are daily, momentarily coming into the field of our cognizance, is developing organisms of every grade from the human form down to that of the simple life-seed, if such exists—the basic protoplasm—and man can only touch to injure or to destroy the beautiful, the wonderful, the incomprehensible creation. As it appears to his wondering mind it is an existence which he can influence only for evil, and an unimaginable enigma which he cannot solve.

Of these two sets of forces, the one is unintelligent as to the direction of its action and indifferent to the results attained by such action, and is governed, under all known conditions, by laws which are as invariable as they are simple. The other class appears to act at all times upon a definite plan, and under the direction of an intelligence which leads to the production of the most elegant and intricate designs and the elaboration of the most wonderful and mysterious of organisms. It is in the structures, which are their work only, that the strange phenomena of life are exhibited to the intelligence which vainly endeavors to comprehend them.

A system which shall be a real science of the advancement of science is thus seen to include :

(1.) Observers, or discoverers and collectors of fact, investigators in the field of research.

(2.) Systematizers of fact and of law—creators of the philosophy of science.

(3.) Teachers of science, expounders of the philosophy and explainers of the phenomena of accepted science.

Each of these classes requires for the proper performance of his work a certain amount of material assistance, and needs both money and apparatus.

Science began her work at a time so remote that her earliest records were made before the historian was competent to preserve them. The Chaldeans had among their astrologers, 3,000 years ago, most accurate observers; for, as Draper tells us in his learned work on the progress of civilization, their estimate of the length of the "Saros" or cycle of eclipses—a period of more than nineteen years—was "within nineteen and one-half minutes of the truth." But until the time of the great Ptolemy, the second of the essentials of the advancement of science, a codifier of its facts and laws, remained a want unsupplied. The East Indians and the Greeks began the study of algebra, geometry and the other simpler sections of mathematical science; but it required a Diophantus and a Euclid to give those departments of science form. Aristotle declared the true principles upon which all progress in science must be based; but it was only when Bacon explained, and when Galileo and Newton illustrated the application of those principles, that the real growth of the existing natural sciences actually became perceivable. It was only then that experimental physical science found practitioners. Previously, all scientific work had been the work of observation.

But why has not the progress of science during the past been all that it might have been? Why is the advancement of science to-day so difficult and irregular and toilsome? Evidently and simply because there has never been created a systematic method adapted to the encouragement of its growth. The right men have never been carefully selected and thoroughly and carefully trained to the work which is most in need of skilled men. Men of science have not always worked in directions which call most urgently for their attention; but have often followed their own unreasoning inclinations into side paths, and they have thus wasted powers which might have given splendid returns for that energy and talent thus expended. The endowment of research has formed no part of a complete scheme for the advancement of science, or, at least, it has never had the attention and the labor given to its procurement that it should have had. The materials and the apparatus placed in the hands of men of science by those to whom they have been compelled to look for material assistance has too generally been insufficient in quantity, and too incomplete in its character to permit the most effective application of their efforts.

For all these reasons and more, we are not to-day, as we have not been in the past, prepared to do all that we should in the advancement of science and of the arts which so greatly depend upon it. Indeed, it is too often the case that the man of science holds himself entirely aloof from the duty, to which every consideration should urge him, of aiding in every way which lies in his power in the advancement of arts by the discovery and invention of methods of application of his knowledge and his philosophy to every one of the industries of common life.

Were he to do this more conscientiously, he would secure to science far more effectually, also, that assistance from the man of the world and from the man of

business upon which he is, despite himself, very greatly dependent. There is certainly no more creditable change than that which we see going on in these latter days, the growing inclination of these two great classes to countenance and to assist each other. Now we come to the practical and vitally important qu stion: What are *we* to do? What methods and what plans are to be initiated and carried out by men of science and the friends of science to secure that advancement of science and the diffusion and application of scientific knowledge most rapidly and uninterruptedly and to obtain a maximum return with the expenditure of a minimum of time and labor. How can we best acquire knowledge of facts, a comprehension of laws, an understanding of their order and relations in nature's code, and, if so much is to be permitted us, how may we hasten that great day when the sciences, now apparently isolated and unconnected, shall be seen to form parts of one magnificent system, each interlinked with others and no one isolated. A system to which all are essential, as the perfect and symmetrical and endless links of chain armor combine to make one complete and infrangible whole?

The method to be adopted is easily stated. It is simple, comprehensive, effective. It secures the maximum efficiency of the individual and it includes the creation and the administration of organizations in which numbers assist by combined effort the acquirement, the diffusion and the useful application of the sciences to the moral, the intellectual and the social advantage of humanity.

The science of the advancement of science dictates that we shall seek:

1. To determine what are the most promising and most important directions of exploration in the great universe of the knowable.

2. That we shall endeavor to find young men fitted by nature and led by their own inclinations to become successful observers, discoverers and philosophers—such men are as rare as are poets. Aid them to gain positions in which their talents may have full scope and assist to make useful the results of their labor.

3. That we make it a part of our work to obtain for these investigators the means of research and the material aid which are necessitated by the rapid and ever accelerating advances of knowledge for which we are indebted to them; to secure the endowment of new schools of science, the more complete organization of older schools, and liberal provision of apparatus and material for every investigator.

4. That we seek to improve our methods of instruction in science, to introduce into our educational systems a better scientific curriculum and far more extended courses, both of pure and of applied science, and to made the position of a teacher of science, viewed from the world's standpoint, a far more desirable one than it has yet become.

5. To make the organization and the operation of our Academies of Science and of our societies for the advancement of science far more thoroughly effective.

6. To endeavor to exhibit to both classes the fact that there exists between

the man of science and the man of business a community of interest; the fact that he who accumulates wealth is largely indebted for his success to him who is unselfishly revealing to him those secrets of nature, without a knowledge of which he and the world about him would be to day in the lowest state of barbarism; and the fact that, on the other hand, it is only by the possession of such means as only wealth can furnish that the astronomer can study the wonders of the heavens, the chemist can pursue his researches among the mysteries of molecular combination, or the physicist investigate the beautiful and most wonderful phenomena which are illustrated in the discoveries and inventions which are so rapidly now succeeding each other. Men of science and educated men of the world must be brought to know more of each other, and must be held in bonds of closer relationship to secure the maximum of efficiency in our methods of advancing science and of securing to mankind its greatest benefits.

The endowment of schools of science must precede the gathering of the fruits of research; but the endowment of schools must be preceded by the enlightenment of the possessors of wealth, and by the awakening of their interest in scientific work. The American Association for the Advancement of Science has been exceptionally fortunate in securing an appreciation among its members of this community of interests. No existing organization has done more—perhaps none has done as much—to bring together the two classes, the workers in science and the non-professional lovers of science.

When such a system of promoting the advancement of science as I have made a weak effort to describe shall have become familiar to all for whom it has an interest, and when individuals and scientific organizations shall endeavor methodically to work by it, we shall see a new revival of learning—a later intellectual renaissance. Let us hope that we may see this taking place during our own time. Let us hope that a century in which that great investigator, Sir Humphrey Davy, brought out what he claimed to have been his greatest discovery—Michael Faraday—shall see even nobler work done by many later Davys and Faradays; that the century that, in its early years, saw the splendid achievements of men like Young, like Rumford and Cavendish, like Laplace, Lagrange, Fourier, and Carnot, of men like Gauss and Magnus, and like our own recently lost Henry, that this century may yet prove even more prolific of such noble sons.

Let us have faith that an age which still boasts of men like Thompson and Joule, Helmholtz and Kirchhoff, of men like Pierce and the long list of his successors to the presidency of this Association, all of whom have won that distinction by their works; that such an age shall see the science founded by Rankine and his comrades, correlated to the other branches of energetics, shall see the wonderful industrial revolution inaugurated by Watt and Stephenson, and Fitch and Fulton, and Stevens and Hoe and the great crowd of great inventors succeeding them completely effected, and the people, relieved from the distresses which unavoidably characterize such violent social changes, happily settled down to their legitimate pursuits, the peaceful acquirement of the comforts and luxuries of life, of

the blessings of education, and of all the refined pleasures which are the peculiar possessions of an enlightened people.

We shall, we may be sure, then see in each advancing year more of the beneficent influence of the advancement of science. Discoveries will succeed each other with ever-increasing rapidity; the now independent sciences will interweave themselves more and more thoroughly, gradually growing into a shapely and perfect whole; the foundation of schools of science will become yearly more frequent, and systems of instruction will be continually improved, until the progress of scientific knowledge among the intelligent classes of our people is only limited by the rate of advance of experimental science.

It is not too much to hope, even if it be too much to expect, that those among us who may be favored with life to the end of the nineteenth century may witness wonders beside which even our telephones, our phonographs, our microphones and our star-detecting tasimeters shall seem commonplace inventions; beside which the "Hoe perfecting press," the present locomotive engine and the mightiest of modern steamships will appear as rude as now do to us the press of Franklin, the halting colliery engine, or John Fitch's steamboats—the wonders of the beginning of this period. In effecting all these changes, in producing every improvement, every advance in civilization, in everything that aids the human race morally, intellectually or socially, the part to be played by the scientfiic man has an importance which can not be exaggerated. He is to furnish the worker in every department of life with a knowledge of the facts and the laws of nature upon which every profession and every trade is based. His is the noble mission to study the works of his Maker. To him alone it is given to read the great book of nature—the only existing infallible commentary on God's written word—and he alone can authoritatively respond to that momentous question, "What hath God wrought?" whether asked by the layman or the professional theologian, and whether it has reference to the objects visible to the eye and to the processes in operation all about us, observable to the senses, or to those opposite infinities which are revealed to us by the microscope and the telescope.

The mission of science is one, the scope of which we cannot fully comprehend and appreciate, but every worker in science and all lovers of science may at least see that it is transcendently important that we should more thoroughly study philosophic methods of science-advancement and seek in every possible way to promote the work of the observer as an investigator, of the philosopher, of the educator, and of him who embodies in useful inventions the knowledge made accessible to him through the advancement of science. It is by studying the science of science-advancement that we shall most effectually prepare ourselves to do our share of this great work.

The next paper, read by Professor Grote, was entitled "Education a Success of Experiences." We give it in full:

EDUCATION A SUCCESSION OF EXPERIENCES.

BY PROF. A. R. GROTE, BUFFALO, N. Y.

Ladies and Gentlemen: The two Vice-Presidential addresses of my predecessors are remembered for the honor they reflect upon American science. That of Prof. Morse, at the Buffalo meeting, two years ago, had for its subject, "What American Scientists have done for Evolution." This address has a permanent historical value, which is only lessened through the modesty of its author, who forgot his own in enumerating the labor of others. That of Professor Marsh, at the Nashville meeting of last year, dealt with the "Succession of Vertebrate Life in North America," and its sketch of the progress of the higher forms of life, however the details may be filled out by subsequent researches, established the certainty of that development by succession as the result of the author's own enduring work. In this address I have endeavored to trace the action of evolution in a further stage, and, in speaking on "Education and the Succession of Experiences," to lay before you a brief study of the growth of the mind.

A study of the phenomena of the human intellect teaches us that there is a process going on by which external matters are being pictured in the brain through the action of the senses. The imagination itself is found to depend upon an ideal grouping of experiences, however fantastic and unconnected they may be made to appear. As time elapses and mankind advances, the brain pictures seem to become more perfect and to embrace more fully the characters of their originals, and their development in this direction is proved by our varying notions of things and our changing conduct toward them. Education may, then, be primarily conceived as the process of storing sense-impressions in the brain, and the total condition and amount of the brain-pictures we might style knowledge. An education seems to resolve itself at last into a succession of experiences, however complex it may appear in its results, so that, in any discussion, it will make the matter much clearer it we study the machinery which makes education itself at all possible. It is evident that we only appreciate sight or any one other of our senses, because it exists; and in the evolution of sense organs, the feeling of the want of them in the individual evidently succeeds their possession of the species. Through the senses a section of the universe is opened to us, a section which is limited by their powers in bringing, and the capacity of the brain for storing what is brought. But with the utmost exercise of our receptive powers our view of the world remains a section still. When we find, for instance, that vibrations of the air below thirty-two and above 100,000 per second make no impression on the human ear, we understand that we are cut off from a wide range of possible sound. So that every mechanical appliance by which we can enlarge the field of experience tends to increase our knowledge, and, therefore, to affect our conceptions of the world about us.

The "atoms" of the intellect are thus seen to be the single sense impressions, and the conclusion is inevitable that reason is generalized experience. It is possible to check the correctness of this conclusion through a study of the intel-

ligence of the lower animals, and the efficiency of their senses. And so far we have found that the generalizations of knowledge which they are able to make, and which we have called in the past instinct, to distinguish them from our own reason, stand in direct relation to their capacity of receiving sense impressions.

It may be said that what the lower animals do know, they come to know by similar means and in the same way that we acquire knowledge, It is now the generally accepted conclusion by scientific minds that instinct and reason differ in degree, and not in kind. Our literature is already full of proof, drawn from the habits of vertebrate and invertebrate animals, that this position is a just one and explains fully the relationship between the intelligences of the different animals themselves, as well as between the intelligence of the races of men and that of lower types of existence. Reason is, then, built up out of past experience, which we use when brought into fresh contact with things. We become more reasonable as we experience more, and the object of education is to impart that reasonableness more quickly, so that the growing generation may not be obliged solely to find how things are from the slow process of its own experience, but profit by the knowledge which was gathered by those who passed away before. Reason, then, depending on the sense impressions, must be affected by the character of the sense organs. If these were more perfect the acquirement of knowledge would be easier. In fact, they are found to be limited and unreliable beyond what we might at first be inclined to grant. But however justly we may distrust our senses on any particular occasion, we can not consider them, or any one of them, as totally unreliable. All that we can do is to point out their insufficiencies, to check the evidence of one sense by that of another, to try by repeated experiment to establish the actual condition of affairs.

The pictures which our senses give us are not to be regarded as false although they may convey a misleading idea of the object perceived, Every action of the senses gives us a comparatively true perception of external objects. A correct judgment is formed after a full examination through all the senses that can be brought to bear on the subject, and in this way the actual state of affairs may be discovered. The method of examination we may employ is determined not only by past experience, but by that analogy which prompts fresh experiments. At bottom this is what makes education attractive, that the mind grows in the direction to receive more and more complete pictures of things. And this is an answer to those who object to scientific hypothesis, that all such, based on observation or sense-impressions, are to some extent reliable and serviceable. It is not true, either in part or wholly, that we "take leave of our senses," to construct our scientific hypothesis, but the reasonableness of our hypothesis stands in relation to the extent of our acquaintance with its subject and related matters. But aside from the imperfection of our senses, which may make a correct judgment impossible, or at least difficult, we find ourselves sometimes under exciting conditions of the brain, when we mistake the subject of our thought for the object of our sense-impressions. False seeing and false hearing have come to be classed among the diseases of the brain, and the evidence collected on this

head points to the conclusion that it is the memory which is here affected. The explanation of memory is, that it is the result of an effort of the mind by which we recollect the pictures and impressions already stored in the brain. The mind, "that veiled enchantress," as Draper calls her, is "veiled" because her feeders are so subtile, that we believe she exists without subsistence. But in all her phases she is seen to depend literally upon the senses for her vigor. The dream-doors of night's dwelling, opening at the touch of sleep, let forth a troop of images seemingly of fresh import, and perhaps of direst consequence. But reason, by simply bringing the figures into their proper sequence, reveals in them the pictures of the day's experience. Before discussing the imperfections of the senses, and which so deeply affect our conceptions, let us briefly consider the way in which one of them, that of sight, receives its impressions and conveys them to the brain.

Young, in his theory of the perception of color, has shown that there are three orders of pointlets or nerve ends of the retina, and that each order of nerve ends is sensitive to a different rapidity of the light waves. Helmholtz demonstrates that certain of the nerve ends in the retina are destructively affected, in both the live and the dead subject, by particular rays of light. We may conclude that the shape of any object, as it appears to us, depends upon the number of pointlets of the retina affected by it, and the color on the order of nerve ends stimulated by it so far as our sight of the object is concerned. The cause of the color of any particular object itself must be sought in the structure of its atoms, which absorb certain of the rays of light and reflect others. Thus all objects may be considered, in a general way, prismatic; that is, they effect a separation of the rays of white light in displaying the phenomena of color, but they do this by absorbing certain of the rays. This is the point where the chemist and the biologist meet—every phenomenon displayed by an object is found to depend upon the ultimate structure and arrangement of its component atoms. We may thus conceive of the action of the sense of sight without calling to our aid anything but the thing seen, the medium through which the thing attacks the eye and the machinery which conveys the picture of the retina to the brain, where it is registered. We may in this way investigate the action of the remaining senses, and with a similar result. Always there is the thing perceived, the media, the contact, the machinery of the sensory nerves and the gray matter of the brain. Defining education, then, as the process of receiving a series of sense impressions and experiences, let us consider in what way our knowledge is affected by the limitation and imperfection of the senses.

We have said that, from the limitation and imperfection of our senses, but a section of the universe is opened to us; in reality, we have but a partial idea of even this section. It will occur to every one that there are a large number of objects which they fail to take cognizance of, although they could do so if they had the opportunity. Such objects as distant portions of the earth's surface, foreign animals and plants, many of us have to content ourselves without seeing. We know them through the senses of other persons, who have written on them.

Nevertheless, our total conception of the world is affected by our personal ignorance of these matters which go to make up the world. But, aside from this class of objects, there are also to be considered the large number of things we pass over from inattention and a want of preparation of the senses to entertain them. How large a class this is we can easily understand when we know that the difference between scientists and other people is involved in the matter. For a scientist is merely one who diligently observes things that for the most part are neither seen or heard or felt by others. Life is also too short to witness the outcome of many things, and the years in which we are willing to pursue inquiry too few. It has happened that generations have elapsed before a new age has carried on seriously the investigations commenced at an earlier epoch.

The eternal appearing and disappearing of things, of which we are a part, it requires all our courage and genius to face and understand. And then, as to the limitations of the senses, we know from the microscope that there are quantities of forms too small for us to know without artificial help, and even correctly with it. We do not recognize objects at a certain distance, and our power of vision is probably surpassed in this respect by hawks and eagles. In similar ways, all our senses have their limitations, which it is the object of art and science to attack in the interest of human advancement. Aside from their limitation as to power, our senses are apt to deceive us, by taking only a particular side of the object, one view, as it were, from which alone we must receive a permanently incomplete, and therefore incorrect, idea. Again the same sense obtains different results under different conditions, as when Pythagoras observed that a stick placed in the water appeared to be broken. We contrast the picture of the stick in the water with its picture in the air, and although both pictures are seen to be correct, we test the truth by the sense of touch and arrive at the conclusion that the stick appears to be broken in the water. This illustrates what I have said before as to our testing the results of any observation by different senses. In this case this testing gave us the theory of the refraction of light and thus enlarged our conceptions of the properties of matter. In an address before the Russian Entomological Society, to which I have only space to allude, Von Baer most interestingly shows how our total conception of time itself is modified by the rate of the circulation of the blood. It is only another instance of the dependence of our conception upon our constitution. So far as we are concerned, we have reached, not the ideal, but the final truth whenever we have exhausted our powers of conception in any given direction and, by a systematized checking of results, arrived at a conclusion. The duty of accepting this conclusion and acting upon it seems to me imperative and is what science demands. Anything short of this is a practical denial of the value of all knowledge, which would lead to the disintegration of society. I hope to show, further on, that science assists the development of the whole State, and adds to the stability of government by publishing its conclusions, and wish to insist here that it is fundamentally beneficial to the same interests in making its observations. But from this imperfection and limitation of our senses comes, not only a succession of experiences which

are incomplete, but a general conception with regard to external matters, which must be of necessity misleading. We are here but a short time and see but little of the outcome of passing events, and can know nothing of the outcome of the world itself. Thus it has come to pass that what we have not fully observed, we have assigned to an unknown cause, We have fitted nature into our own measure, directly led thereto by the imperfection of our knowledge, and we have arrived at the concept that design exists in the world about us as it is displayed in our own handiwork and the work of animals, which, with ourselves, exhibit design in their operations. But in reality what we see in the details of the structure of animals and plants is not design, but adaptation. Suppose we leave a coat in a closet, and while it is there it is visited by a female clothes-moth, which deposits thereon numerous eggs, The little worms hatched from the eggs would at once commence to make free with the nap, and eat holes in the coat with a good appetite. If they ever thought about the matter, would they not conclude that the coat was hung there for their special benefit? They would do so merely because the coat was there. The fact that they adapted it to their own use would be construed by them into a belief that it was designed for their benefit. They would inevitably regard the owner of the coat, could they arrive at this conception, as their benefactor and the preserver of the whole race of maggots. They would know nothing of the thousands of clothes-worm eggs that perish because they never get anything to eat. The fact that life is sacrificed by the wholesale in nature tells against the argument of design. And nature is as careless of the species as of the individual. In the crust of the earth are contained the remains of millions of types of forms of which nature has not been careful, but has crushed them out because they could not adapt themselves to the changing conditions which surrounded them. And just as the human body displays an incomplete adaptation as seen in our possession of useless parts, such as the vermiform appendage, which is present also in the anthropoid apes, so our sense organs are seen to be affected. The hyaloid artery of the eye, present in the earlier and already absorbed in the latter inter-uterine stages, is sometimes persistent after birth. Liebreich records in the transactions of the Pathological Society an instance of the persistence of this artery in a boy of sixteen. In New York Dr. Callam found three cases of persistent hyaloid artery in examining the negro school children, and it is a question if this disability is not more frequent in the inferior races, as, indeed, we should expect it to be. There can be no design in an imperfect sense organ, but imperfect sense organs nevertheless exist. And, indeed, any study of the eye is incomplete without studying the eyes of lower animals. In studying the development of flounders, Prof. Alexander Agassiz found that at a certain stage of growth the right eye sunk into the tissues of the head, penetrating into the space between the base of the dorsal fin and the frontal bone. Prof. Agassiz has been able to follow in one and the same specimen the transition of the eye from one side of the head to the other. With this change in the position of the eye is associated a change in the position of the body when swimming, for before this the flounder swims vertically, but at this time they com-

mence to lie on one side. We may conclude with Wilson, that since this distorted condition is shared in a lesser degree by a variety of other fishes, and thus a succession of steps is furnished, it points to an adaptation by an inheritance, although it is possible that there is a nearer solution to be drawn after we know the habits of the flat fishes more fully. But throughout the scale of animal life the senses are seen to adapt themselves everywhere to their surroundings. The eye which in man is moveable in its socket, and has a pupil which may be dilated to accommodate itself to the different rays of light, ceases to present these and other adaptive characters as we descend the series of animal life. We come at length to the special series of blind animals, such as the eyeless crab, *Willemoesia,* found by the Challenger expedition in the ocean depths, which wants even the eye, stalk and pedicle, and seems to have no occasion for sight, where the light will no longer penetrate.

To the conception of design is linked the idea of creation out of nothing. Both arise from the limitation and imperfections of our sense organs, and my thesis is that creation and design, as opposed to evolution and adaptation, are the results of being satisfied with the surface impressions we receive, and not checking and testing the results we may obtain from one only source of knowledge. There are certain Indians in the West, of whom Major Powell tells us, who believe that grass grows but that trees are created. And among them are likewise certain philosophers who think that both grass and trees grow, and who have a hard time of it in consequence, and with whom some of us in more civilized society may sympathize, though at a distance. It must not be taken for granted that even the slightest extension of the conception to include trees makes intelligent men out of these Indian philosophers; it shows that there are many grades of intelligence in this direction. The sources of intelligence are so various that we cannot come to understand the result as displayed by the individual without knowing more facts than we can get at. If we know the environment we can know the individual, and this fact is virtually admitted by all students of character. But to know the environment! how difficult, one is tempted to say, how impossible! But, perhaps, we can follow out our argument and at the same time attempt some classification of our knowledge, which will assist us in the study of the effect of the environment on the mind.

We have seen that we may conceive our knowledge as the total results of our sense impressions, and education as the process of acquiring these impressions. When we examine the sources of our knowledge, it will be found, I think, that we have attained it in two kinds of ways, and that for convenience and a better understanding of education itself, we may take these two ways as a rough classification of our knowledge itself. The one is by direct experimental contact with things, and this is the most positive and certain, so that we may call the knowledge we acquire in this way real. The other way is through books and the teaching of persons other than ourselves, and we may call this kind of knowledge second-hand. In the process of education we draw upon both these sources of information, and both go toward determining our total mental status. They are,

in fact, so interlaced that we have difficulty in separating them. What we have read about often seems only to be separated from what we have experienced by its lesser vividness, and the art of teaching evidently lies in the power of presenting second-hand knowledge so that is has the force, or nearly so, of an absolute sense presentation. Undoubtedly there is a certain ease and facility in acquiring second-hand knowledge which renders the process attractive to the mind; the mind, which, as we have said, grows in the direction of receiving information. But this second-hand knowledge carries with it the greater possibility of error. We have only to recollect that our second-hand knowledge is imparted to us through the machinery of words, and words, we all feel, but approximately express our ideas. This fact supplies the reason for the success of object-teaching in education. Undoubtedly the second-hand information of to-day is not the best information now possible, but, as a whole, it compares favorably with the second-hand information of twenty years ago.

From the fact that the vast majority of us acquire our conceptions of external things largely during our school and college days, there is an evident reason for the popular unfriendly attitude towards new ideas drawn from experiments unknown to the past generation of school children. Between this second-hand information and real knowledge there is seen to be a constant inter-action; the first is always improved by the results of the latter, and so mankind is instructed as time elapses. The proceedings of our scientific bodies contain a mass of information which is brought later on into our school-books in different shapes.

The effect on the minds of the rising generation is cumulative, and most children start with ideas and a presentation of facts with which their parents perhaps finished their education, and few of us, we know, actively pursue our studies during mature life. But here we must be struck with the fact which a study of the inheritance of certain faculties of the mind present. Much, we know, almost everythin,g is transmitted from the parent to the child, and along with the copy of the structure, the resemblance is carried out into minor details of form and feature. And in the same way the structure of the brain, which we yet fail to well understand, is affected. The faculty for receiving a certain class of brain pictures rather than another, the bent of the mind in a certain direction, follows with the color of the hair and eyes and the shape of the skull. But this faculty may exist and at the same time an absence of the brain-picture, which would satisfy and fill it, may cause its obliteration in the child from disuse. We must then clearly distinguish the factor of heredity as affecting the sensory nerves and the brain, when we consider the total mental condition of the individual. The action of the senses and the exercise of the brain beyond a certain extent, which varies with the individual, are painful and therefore distasteful. Up to what point they may be carried in any given case is difficult to determine. Sufficient it is for us to appreciate that, for the mass of mankind, a small total amount of sense and brain work suffices, and that we are generally willing to avail ourselves of the less tediously acquired knowledge which we receive through books. And even these it is almost usual to read carelessly and to avoid comparing, taking the remarks of author after author

listlessly into our minds, until our reason is clogged with contradictory impressions and our total mental attitude becomes feeble and vacillatory. And here this fact presents itself, that in proportion as we apply to the sources of our real knowledge, and generalize from the results of our sense impressions, we are able to criticise our second-hand information, and work toward a truer apprehension of ourselves and the world we live in.

Those who rely chiefly upon second-hand knowledge in effect refuse the present opportunity, which is alone their own, and must necessarily accept a lower philosophy of their lives. And by philosophy we mean, after all, an explanation of ourselves and the world in which we are. The range of meaning in words is so great that ordinarily we conceal under this term one knows not how much that is mysterious and that may be even held unnecessary. But by philosophy we evidently mean that correlation between the brain-pictures by which that which is contradictory is explained or brought into its true succession. We all know how comparatively easy it is for us to entertain contradictory beliefs, and how we do not even notice this contradiction until we come to compare our ideas, which we do not all of us try to do. But something of a philosophy we all of us attain to as the natural result of our sense impressions. As we rise to general conceptions we bring this philosophy to bear upon them, and we are apt to answer very difficult, even unanswerable questions, in a way which at once measures our knowledge and tries our judgment. Even when our philosophy gets damaged by facts we go about with it and wear it in some fashion, still preferring the old cover to the exertion of getting a sounder one from new sense impressions and a sounder correlation of ideas. But our philosophy or mental condition towards the rest of the world is of vital importance, since from it we derive much of our happiness. A life is often wearily spent in struggling to face even very ordinary mental difficulties, in the endeavor to reconcile our experiences with our derived ideas.

What is needed, then, is some more accurate comprehension of what we are and to what things are tending, and to get at this we must lay under contribution all the possible sources of knowledge. From a conscientious application to the evidence of our senses we may come to some certainty of what things are and have been, and from a careful study of literature we may find out the direction of development in human affairs. The result of both these lines of investigation to the student is a culture as high as the amount of labor he has expended, and a happiness as complete as his mental development is equal sided. In any event this culture will be found to confer upon its possessor immunity from many of the sorrows of this life.

But obviously this total happiness depends on the correctness of this, his philosophy upon which it rests. A picture on the brain, received how it may be, if partial only, is nevertheless lasting, and has its effect in deciding the mental tone. And from these incomplete pictures we arrive at false or incomplete conceptions. In this way the persistence of ideas may be explained by the persistence of the physical impress on the brain and the mental labor requisite to alter or erase such a partial and misleading picture is always great. Great in any

event, it becomes too heavy a task for many of us when the pictures have most of them taken this turn. We are then committed to a wrong view of life, and must suffer the consequences. We must share in this event the average happiness which the defective philosophy to which the pictures lead us ensures. And the way in which pleasure and pain generally arise is the same as the way in which they come to the sense organs and the nerves. Pain arises in the body when any sensitive portion is torn or interfered with, and again where the wearing of the tissues is greater than the supply from the blood of the waste, as in being tired, or hungry, or thirsty. Pleasure arises from as vigorous an action of the organs of the body as can be maintained without expending more force than is supplied to the tissues and nerves from the blood. And exactly in the same way, by wear and tear, we find our senses affected. So that the conclusion is inevitable that the injury we inflict on the total organism from undue exercise of the senses is as pernicious to its proper development as excessive muscular work would be. The intellect, as distinguished from the emotions, is that part of the mind which discriminates and appreciates differences, but this fails us, too, after severe studies. A hard example in arithmetic, for instance, and a difficult feat in gymnastics present similar demands on the system; and at a certain age, indeed, the amount of vital repair necessitated by the first may be greater than that demanded by the second.

To trace the growth of the human intellect from before the earliest historic period until the present time is a work of immense labor and is one that is engaging the attention of the greatest minds. I can only attempt in a simple way to give here the more evident marks of its progress as seems to me approximately correct, and which I have on another occasion brought briefly before this Association. But before doing so, we may refer to our present knowledge with regard to fossil man. In a late address Dr. Virchow has seen fit to dispute the value of this evidence as bearing upon man's evolution from a lower type of animal life. In effect, the evidence being fragmentary, is also to some extent contradictory. But leaving out of sight the proofs from American sources brought together by Prof. Morse in his address before this Association, Mr. Henry Gilman's researches in Michigan, and the subsequent dicoveries of Dr. Abbott in the gravels of New Jersey, I wish to point out that the capacity of the skull is no absolute criterion of the intelligence between certain limits of measurement. As a fact the heaviest brains yet known did not belong to persons of the greatest mental power. Whatever, then, the capacity of the prehistoric skulls of Europe, the implements which their owners fashioned, the relics which we possess of their social life, are proofs of the low intelligence of these ancient men. Whatever their brains might have weighed, the direct evidence is that these people were far below the races that have succeeded them, in knowledge. The opportunities of the cave-dwellers were not golden, but flinty, their experiences few, their lives poor. Unless we are willing to cancel all we have yet gathered from antiquarian sources, we must admit that the evidence, as it stands, makes directly for the argument of mental evolution. And looking at this change in the minds of men

through the historic periods, and which is going on to-day, we may trace it to the material causes, because we must consider that education and intelligence have a material basis, as I have tried to show in this address. And we cannot separate in any essential way the development of the mind and that of the body, the one being conditioned by the other. That development seizes on certain organs or parts of the body especially, we know from the studies of Profs. Marsh and Cope, among our own Palæontologists, and it is quite clear that in man the development of the body has for some time been less active than the development of the brain. It is the immediate environment, which acts on the organism, and man, in social communities, is no longer chiefly dependent upon muscular vigor, but upon mental activity, for a successful existence. But corroborative evidence of the development of man from a lower type of animal life, so far as his physical development is concerned, we find in the fact that for every bone, muscle, or organ in man there is a corresponding one in the anthropoid apes. It must not be left out of sight that any special distinctions of this kind between man and certain apes have been found totally wanting. All the differences now recognized, including that of the cubical contents of the brain case, have been found to possess only a comparative value from their range of variation in different apes and in different men. This much we can, therefore, clearly show, that the difference between man and certain lower animals is a quantitative and not a qualitative, one. With this and the arguments from embryology and from mental evolution, the case of the total development of man stands, we must think, on very firm ground, even without the assistance of the analogies to be made with the development of other organisms, and without drawing on the possible future discoveries of palæontologists, the character of which might be justly inferred from what has been already presented.

A work of immense labor it is to unravel the network of complex thought which surrounds us to-day, and determine the origin of the separate threads. Such a labor is comparable to that of the biologist, who, through a succession of different but allied species of animals, traces the origin and modifications of a bone or muscle. But so much exists upon this subject already that I have ventured to give the material points of our mental progress, which may possibly assist us in our conceptions of the successive stages through which the mind of man has already passed. At the outset we cannot too strongly insist upon the comparative value of such terms as "civilization." Our general tendency is to give a fixed value to such words, measuring them by our own standard, and to this unconscious action, which has a wide application, and from which nothing but culture will free us, deeper thinkers have given the name anthropomorphic. In this instance, since our civilization is constantly changing, we can only consider ourselves as standing on a plane of comparative excellence, while a comparison of our own with the civilization of the Chinese, Hindoos and Japanese shows us that in some few points, it may be, we have a lesson to learn; while in others, as in the character of criminal punishments, these nationalities occupy ground that we have abandoned centuries ago. The motor of civilization must always

consist in an improvement of the machinery for the exchange of thought. This follows from our conception that our intelligence results from our sense impressions on the brain, and that we understand by education the process of acquiring these brain-pictures. Clearly, the acquirement of articulate speech marked the first advance in human communities in mental evolution. It does not appear that we know how articulate speech came to us, although we may hope that in the disintegration of vocal sounds by some such invention as the phonograph, a reasonable theory of its successive steps may be brought out. The first marked advance upon the formation of language lay in the discovery of the characters of writing which we call phonetic, the steps to which were marked by the use of different grades of object signs. Through the invention of writing, a man's experience in this world was not lost when Death struck him dumb. For the earliest writings we have retained a special reverence which lasts until to-day, and has not been dissipated by extended familiarity with the process. The next step lay in the invention of printing—always following the same line of advance which mental development had marked out from the first, the growth of the mind toward receiving more and more perfect brain-pictures of external things, and the effort to assist this growth through the dissemination of ideas. Before the invention of printing, an important part of the process of education was limited to the few, because these alone possessed the art of writing and the means to secure collections of manuscript of different kinds. Hence the difference between ancient and modern civilization lies chiefly in this, that in the former the masses could be improved from outside of themselves by the orator. The printing press, at a later time, enabled the people to take the orator home with them, and review at any time his messages. In ancient times writing required to be read, and the stated re-reading came to be a custom in public before the action graced the hearth at home. So we may consider the advance of mental intelligence to be marked by these three great inventions: speech, writing and printing, while in our own day the spreading and perfection of our intelligence has been aided by the kindred inventions of the telegraph and telephone. Civilization thus appears as the consequence of the dissemination of experiences among mankind.

Those who have brought together the story of the ancient civilization of Greece have agreed with unanimity that the separation between the mass of the people and the intellectual portion became at length insurmountable, and finally led to national destruction. This makes for our own view, that it was to a defect or incompleteness in the machinery for the dissemination of knowledge that we must ascribe the dying out of the older States. An intellectual aristocracy was established in Greece, which, in order to maintain its superior position and from natural and selfish motives, endeavored to prevent the spreading of new facts, but it was assisted in this action by the limitation which an ignorance of the art of mechanically duplicating writing threw around it. Philosophers have explained the fall of Greece by considering it as a necessary step in the progress of humanity and the perfection of a future bloom of knowledge. And so in one

sense it may be, but still, exactly where the defect lay and where there is a positive advantage in the conditions of modern civilization and wherein modern civilization more adequately protects the State, has sometimes escaped them. To understand this fully we must come back to natural history, to anthropology, at last. A large class of persons with a certain bias persistently decry our modern civilization and look for its more or less speedy evanishment, merely because Rome perished and Greece decayed.

But nowhere in nature is there exact repetition, and to understand the new civilization we must remember that it rests on a larger average intelligence, brought directly about by the discovery of the art of printing. There is then a distinct reason, a scientific ground, for the opinion that our present civilization rests upon a surer basis than did those which preceded it, and this we may safely bring forward in the cause of truth. For science is in danger always of being regarded as the enemy of the State, because it tends constantly to modify existing ideas. But if we can show the necessity for a constant modification of our ideas, arising out of our own constitution, then it may be seen to be unreasonable to defame those who follow the search for truth. And it being undoubtedly true, as Locke says, that of all the men we meet with, nine out of ten are what they are, good or evil, useful or not, by their education, we can see how wide reaching the effect of our improved basis of civilization must be upon us as a people, and how important it is to understand the real direction in which it works.

But, indeed, the position I have tried to sustain in this address lies outside of any criticism of modern education. I have tried simply to show the way in which our modern civilization has grown up, and its real superiority over ancient culture. From this we may rest assured that science, while it influences, can never be an enemy of the State, and that the danger of the State, as well as other social systems within the State, will lie in the direction of an opposition to scientific truth and the right reason of mankind. But it remains for science to play a distinct part, in the discharge of its full duty to the community, by popularizing its discoveries. Doing this, it will insure the stability of the State by increasing the general information of the people. Through the instrumentality of publications, particularly such as the New York *Tribune Extras*, the *Popular Science Monthly*, and the *American Naturalist*, this work of reaching the people is being specially undertaken. But indeed the work of science is being aided generally by the newspaper. And in this work an association such as that we enjoy can take an active part by giving popular lectures. There rests upon us, then, a responsibility deeper than the perfection of our own knowledge—we have to spread it in the interest of the whole state. Gratitude to those who generously entertain us at our annual meetings, should at least prompt us to give in return the knowledge we possess in its easiest shape, while we may confidently hope that in so doing we are aiding the prosperity and peace of our common country. And beyond these there is the future Man for whom we are always working, and who is to be wiser and happier than we can ever be.

The demand has come up from teachers throughout the country that they should be informed as to the manner in which the sciences should be introduced into the schools and the matter be taught. It is the duty of this Association to furnish the information. If we have not sympathized with this inquiry in the past, let us assist it in the future. It is quite evident that the sooner this Association commits itself as a matter of principle to the furtherance of science among the people, the more following it will have and the greater influence. And if it does not it will fall behind its peculiar duty and out of the line of advance in human thought. This Association must be prepared to demand more time for scientific studies from the public school authorities, and it must show to every one that education is a matter which not only falls properly under its cognizance, but which it is also prepared to take hold of. This Association should no longer delay to bring all its forces to bear upon the question of science as applied to education. While it does not do so it will always seem to shirk a duty and ignore one chief end of its existence.

Adjourned.

On Thursday the Association met at 10 a. m., and after transacting some routine business adjourned, after which the following papers were read before sections A and B and subsection C:

Prof. F. W. Clarke, of Cincinnati, Chairman of subsection C, on chemistry, delivered an address on

THE CULTIVATION OF CHEMISTRY.

To the members of this subsection the economical achievements of chemistry are familiar as household words. As we look about us in our daily lives, we see in every direction the fruits of chemical investigations. Every scrap of metal, all paints, oils, varnishes, fats and fertilizers, every bit of glass or porcelain, every cake of soap or box of matches, embodies some improvement which our science has made. Our linen is bleached and our outer garments dyed with the products of the laboratory. Whether we burn candles, gas or kerosene, we still have chemistry to thank for the cleanliness, convenience, brilliancy, purity and cheapness of the light. In many articles of food and in a long list of medicines, in the photograph and the galvanic battery, by the conversion of waste rubbish into objects of use and beauty, in short, through a vast network of improvements and discoveries, our still infant science has established its claims to recognition as a benefactor of mankind. Would that the multitudes who have enjoyed these benefits might see their sources as clearly as we do! Then would science be fostered and encouraged, where now it struggles feebly to secure a grudging and scanty support.

(Prof. Clarke illustrated the value of chémical inventions by the well-known Le Blanc soda process.) In 1814 sal soda was worth $300 per ton. In 1861 it had fallen to $22; 5,000 tons per year were produced, and over 10,000 men employed in the process. Since soda is used in the manufacture of soap and glass, these articles were proportionately cheapened and the demand for them greater. The application of the process created a new demand for sulphuric acid, and so

stimulated that industry and every other in any way depending upon it. In short, the results of the Le Blanc process, direct and indirect, can be traced into nearly every department of human industry, and they have been exclusively beneficial. Thus each discovery of the chemist is like a grain of corn, small in itself, and yet a germ from which may spring the food of numberless future generations.

In every science there is some central line of growth to which all details are subordinated, and along with its fundamental principles find their readiest and most logical development. Without such a main stem a science would be but a mass of scattered details, isolated facts, fragmentary principles, with little coherence or order. In physics, the doctrines of the conservation of energy and of the correlation of forces are points on the central line. In natural history the theory of evolution indicates a main stem. How is it with chemistry? Among chemists to-day there seem to be two schools. One school seems to take an interest only in the statical side of the science; its chief aim is to prepare large numbers of new compounds, and to theorize upon their constitution. It is as if chemistry were to be defined as the science of speculating upon the possible position of theoretical atoms within imaginary molecules. The other school may be described as essentially dynamical in its ideas. It sees in every chemical reaction three objects of study: the substances which enter into the reaction, the phenomena which occur during the reaction, and the substances finally produced. The second term, which involves all the transpositions of energy, is to them of equal importance with the others. They strive to see each change in all its relations; to study processes as well as results; to recognize the connection between chemistry and other sciences. This method of study is plainly the deepest and broadest, and includes all there is of value in the other. This feeling, I believe, is justified by history. Much of the progress of chemical science has been on the physical side. Chemistry and physics are one at bottom and cannot be truly mastered apart. Either, stripped of the portion it owes the other, would be poor indeed. They are branches from one common line of growth. One of the main objects of science is to render prevision possible. The more thorough our knowledge, the better are we able to predict discoveries, and to tell what lines of research will be most fruitful. The line which leads most directly to definiteness and precision is the true line of growth for us to find and to follow. Exactness renders prevision possible. To-day, notwithstanding all her brilliant achievements, chemistry is an inexact science. In experimental resources it is wonderfully rich: in delicate methods of investigation no science can surpass it; but in those principles which render foresight possible, chemistry is poor and meager. We may guess the existence of some undiscovered compound, but, until we have actually prepared it, we can tell nothing of its properties. We are, in fact, but laying the foundations of a future science which shall be to the chemistry of to-day what that is to the alchemy of the past. All that has been done by the chemist for humanity, has been done in spite of difficulties and defects; but enough has been done to prove the possibility of more. There are in chemistry three central problems upon which all else depends: 1. What laws govern the transformations of energy

which occur in chemical changes? 2. How are the proportions of compounds related to those of the elements contained in them? 3. What is the nature of chemical union? These must be studied together, each in the light of the other two. They need for their solution severe experimental researches, the exact determination of numerical data, and reasoning of a rigidly mathematical kind. Speculation should be used only as a line by which parts of the work may possibly be helped and guided. We already know tolerably well *what* transformations of energy occur in chemical changes; the question now is as to their quantitative relations. How much heat appears or vanishes in any given reaction; what is the exact electromotive force of any specified couple; what numerical expressions connect actinic energy with particular combinations or decompositions; these are questions that science now asks, and for which, in a few cases, she is beginning to find answers. If we are to determine what general laws connect the properties of compounds with those of the elements contained in them, we must first secure a large mass of well-established data to work from. For a very large number of substances all the physical constants must be rigidly determined, over and over again. With such data we may reach the desired laws; without them we can see but very little. Fragmentary researches of this kind have already been carried out, but very imperfectly. The discrepancies among existing data are amazing. Some of them may be due to bad work, others to undiscovered allotrophy or isomerism. Of all the measurements upon which we now rely, at least three-fourths should be re-determined; and even then our material would be insufficient. The research of this kind most immediately needed is the accurate determination, quantitatively, of all the physical properties of all the so-called elements. This would supply evidence directly bearing upon all three of the great problems. Such work has not yet been done for even one of the sixty-five elements now known. Take iron, for example, upon which so many practical experiments have been made; in these more purely scientific relations we know it only on the surface. Not a single series of physical constants has yet been rigorously determined for it. The reason for such incompleteness is evident. Hitherto the labor of research has fallen upon the shoulders of volunteers who have worked independently of each other. Part has been done by teachers in their moments of leisure; part by manufacturers or inventors with reference to practical problems. Our pure science has grown unsystematically, and our applied science has been imperfectly applied.

What chemistry needs is a combined effort upon some general plan. Much would be accomplished by an endowed laboratory for research, in which a trained corps of specialists should co-operate upon those investigations which are too large and arduous for individuals to undertake. In such a laboratory the physical properties of substances could be accurately measured; methods of measurement could be tested and improved; the quantitative relations of the forces could be exactly ascertained. By the precision thus gained in science, every industry involving the applications of science would be directly benefited. The special problems of the iron master might not be touched, and yet evidence would be

discovered enabling him to solve them more easily than before. The practical as well as the scientific value of the institution would be enormous. Can not this conception of a laboratory for research be realized ? In every city there are rich men who owe their wealth to applications of science. Surely some of the riches she has created ought to return to her benefit. Every day we hear of large gifts to colleges, museums, hospitals and other charities, and there must be men who would give liberally to aid our science if they knew of her needs. Let the nucleus of such a laboratory as I propose once be established near some large university, or in connection with the Smithsonian Institution, and it cannot fail to grow and become a national glory.

In Europe the needs of science are provided for by Government. Here it might not be judicious to ask the nation for a laboratory of research. Still, there is one other kind of laboratory which Congress might properly establish. Our Government is continually obliged to employ experts in chemistry for researches in connection with the public service. Nearly every department in Washington has work of this sort to be done. It is now done in a scattered way, with imperfect means, and often less thoroughly than is desirable Would it not then be a measure of true public economy for the Government to establish in Washington a thorough laboratory, in which the public work might be done? The work must be done somehow, and would be better done in this way. Such a laboratory, properly manned and equipped, would be of direct material value to the public service, so that the question of its utility could never be raised.

In conclusion. Prof. Clarke urged upon his associates the importance of establishing in this country a good chemical journal. The researches of American chemists are steadily increasing in number, extent and value. Work like that of Wolcott, Gibbs, Cooke, Lawrence Smith, Mallet, Remsen, Jackson and a dozen others, we may well feel proud of. At present this work is scattered in various periodicals, and some of it effectually buried out of sight. We need a good chemical journal, in which all the work done in this country shall be fairly represented. We might have a periodical equal to any in the world; and it is to be hoped that we may not have to wait long for its establishment.

Prof. Clarke, chairman of subsection C, on chemistry, presided, and Prof. Thurston read "Notes on Antimony Tannate," by Mrs. Ellen S. Richards and Miss Alice M. Palmer, of the Massachusetts Institute of Technology, Boston.

The regular session of Section A was resumed, Prof. Thurston presiding. Albert A. Michelson, Ensign United States Navy, Annapolis, read a paper on

"EXPERIMENTAL DETERMINATION OF THE VELOCITY OF LIGHT."

This paper was considered one of the most important before the section, but it is impossible to present a proper idea of it without the diagrams accompanying it. But three scientists, Foucault, Fizeau, and, more recently, Cornu, Mr. Michelson said, have sought to ascertain accurately the distance of the sun from the earth. Foucault used the method known as that of "Wheatstone's Revolving Mir

ror," the application of which was first suggested by Arago. Fizeau and Cornu both used another method, known as that of the "toothed wheel." In Foucault's experiments the distance traversed by the light was twenty meters. The result obtained by him was 185,200 miles per second. Cornu's stations were about fourteen miles apart. The result obtained by him was 186,600 miles, which exceeds the former by 1,400 miles. The objection to Foucault's method is that the displacement, which enters directly in the formula, is very small, and therefore difficult to measure accurately. The objection to Fizeau's is that the time of total disappearance of the light was necessarily uncertain. The object of Mr. Michelson's experiments is to increase the displacement in the first method. This can be done in several ways: (1) by increasing the speed of the mirror; (2) by increasing the distance between the two mirrors; (3) by increasing the radius of measurement, i. e., the distance from the revolving mirror to the scale. In Foucault's experiments the speed of the mirror was four hundred turns per second; the radius of measurement was about one meter, and the distance between the mirrors was about ten meters. The displacement obtained was about 0.8 millimeters. In Mr. Michelson's experiments the speed of the mirror was but one hundred and thirty turns per second, but the radius of measurement was from fifteen to thirty feet, and the distance between the mirrors was about five hundred feet. The displacement obtained varied from 0.3 of an inch to 0.63 of an inch, or about twenty times that obtained by Foucault. With a greater distance between the mirrors and a better apparatus he expected to obtain a displacement of two or three inches and to measure it to within one-thousandth part of an inch. Tables of observation of the velocity of light in air were given by Mr. Michelson, the mean result being 186,508 miles per second. Mr. A. G. Heminway, of New York, contributed $2,000 for the purpose of carrying out these experiments.

The members of Section A of the Association were so pleased with the labors of Mr. Michelson that it was determined to use all endeavors to get Congress to make an appropriation to enable him to make further experiments.

On reassembling, after a recess of half an hour, Prof. Thos. R. Baker, Millersville, Lancaster county, Pa., gave experiments in an improved method of ringing a bell in an exhausted receiver. Prof. Chas. A. Smith, of Washington University, read a paper on

THE ECONOMIC USE OF STEAM.

The following is a summary of the paper: In the use of heat converted into mechanical force by means of the steam engine, so many points arise and such complex problems are found that any paper within ordinary limits will, of necessity, be incomplete. In the ordinary process of converting heat into mechanical work the following operations are always gone through with in order:

1. The development of heat from the fuel by the chemical actions taking place in the process of combustion.

2. The transfer of the heat there developed to some fluid, usually water, causing certain changes in the fluid.

3. The transfer of a portion of the fluid from the place where it receives heat to some place where, by change of volume, it can do work.

4. The change of volume of a portion of the heated fluid whereby the heat is converted into mechanical force.

5. The transfer of this mechanical force to certain contrivances or places where it may be used.

6. The means for using the force thus transferred.

Now, each of these operations is, in itself, a great study, and each of them has absorbed the great life work of many earnest men. Yet, to the ordinary mind, a great confusion still exists concerning these widely distinct processes, and it is oftentimes convenient to look only at the results, as from the commercial standpoint; but he proposed briefly adverting to some of them in order, and to illustrate such points as may be brought up by examples gathered from various sources. The difference in burning soft and hard coals were considered, as also the great evil of using too much air in the furnace, which has been clearly shown by experiments in this city. [This was afterwards confirmed by the Vice President.] The various losses of heat caused by the excess of draft, radiation from furnace and boiler were then discussed, and methods of suppressing them indicated. After this the losses caused by wire-drawing and throttling with clearance, were adverted to. After this the subject of cylinder condensation was taken up and credit given to Mr G. B. Dixwell and Prof. Whitaker, of Boston. The action of steam in a cylinder was discussed under various hypotheses, and the little gain to be expected from the addition of a condenser to a high pressure engine under the usual conditions was explained and the causes indicated, and the extra precautions required for the use of steam expansively were pointed out. The discussion of the action of the compound engine was brief and explicit. The whole paper may be summed up in the statement that the writer wishes to have the fire as hot, use the steam as hot, and keep it as hot as possible till it has been used, and to use it to as great a range of temperature as can be found practicable. The paper included extensive tables of boiler and engine trials.

Prof. Thurston then read a paper on

"FRICTION AND ITS LAWS, DETERMINED BY RECENT EXPERIMENTS."

He quoted the generally accepted law of friction, as stated in the text-books, as follows: "The resistance offered by friction, where two bodies, forced into contact, slide upon the other is directly proportional to the pressure, and is independent of the area of rubbing surface, and of the velocity of rubbing" This law, the Professor said, although approximately correct for solids, sliding one upon another, provided no abrasion takes place, is quite incorrect beyond that limit. It is also entirely incorrect as applied to lubricated surfaces. In this case the resistance follows an entirely different law. Where two rubbing surfaces are lubricated with oil, it is obvious that they, being separated by a fluid film, the resistance to the relative motion is not due entirely, even if at all, to friction of

solids, but must be produced by the resistance of the fluid to molecular disturbance, since with good lubrication the solids are kept apart and out of contact with each other by an interposed film of lubricant. It is therefore evident that the resistance to motion must follow a law intermediate between that governing the friction of solids and that of fluid friction, approaching the latter more closely as the lubrication is more perfect and the separation of the solids is more complete. Under such conditions, two limits may be noted to the law governing resistence under ordinary circumstances 1. When the pressure is made excessive the unguent is forced out, and the solids coming in contact, abrasion occurs, producing a sudden and great increase of resistance. 2. When the pressure is diminished a limit is finally reached at which the resistance to motion is due to the viscosity of the unguent, and this is still effective even when the rubbing parts are relieved of all pressure. The law of variation of resistance is then that of fluid friction merely. Speaking of friction with varying motions, the writer said Prof. Ewing had suggested that there probably existed a law of increase of friction with decrease of velocity which holds good throughout the whole range of velocities down to zero of motion, when the co-efficient of friction of motion changes, by a continuity of variation, into that for starting from rest. The writer, however, found the change from the one condition to the other to occur very suddenly at all ordinary speeds at the instant of coming to rest, and the friction at the instant of stopping is always much below that of starting, although greatly in excess of that for motion at all speeds in ordinary work. A great variety of tables were submitted, illustrating the amount of friction under various conditions. It was shown that the variation of pressure produces a very great change in frictional resistance, as measured by the co-efficient. A diagram of a machine, devised by the writer, was shown, with which it was attempted to secure a means of placing the lubricant under precisely the same conditions of actual service, and at the same time to provide facilities for observing its behavior, and of obtaining exact data. This machine was exhibited at the Centennial.

The following papers were read before

SECTION B:

Ancient Mounds in the Vicinity of Naples, Scott county, Illinois. J. G. Henderson.

Ancient Glacial Action, Kelly's Island, Lake Erie. Chas. Whittlesey.

On Hybrids in Nature. Thos. Meehan.

Notes on the life-history of the Blister-beetles, and on the structure and development of the genus *Hornia*. Chas. V. Riley.

On the larval growth of *Corydalus* and *Chauliodes*. Chas. V. Riley.

Description of two Stone Cists discovered near Highland, Ill. Arthur Oehler.

Description of a Cliff House in the Cañon of Mancos River, Colorado, with a ground plan of the structure. Wm. F. Morgan.

Remarks on the Ruins of a Stone Pueblo on the Animas River, New Mexico, with a ground plan. Lewis H. Morgan.

Observations on the San Juan River District, as an Important Ancient Seat of Village Indian Life. Lewis H. Morgan.

On the Sources for Aboriginal History of Spanish America. Ad. F. Bandelier.

Of these two papers, the last one—by Mr. Bandelier—was considered to be very valuable, and will be printed in full in the Association's Transactions. Mr. Henderson's paper on the Naples Mounds was elaborately illustrated by diagrams, and by a unique collection of curious mound relics, such as pipes, celts, etc. One of the stone pipes, representing a paroquet astride a stem, attracted great attention.

The entomological papers of Prof. Riley manifest so much original research and careful study that we present full abstracts of them both.

NOTES ON THE LIFE-HISTORY OF THE BLISTER-BEETLES AND ON THE STRUCTURE AND DEVELOPMENT OF HORNIA.

BY PROF. CHARLES V. RILEY.

(*Abstract.*)

At the Hartford (1874) meeting of the Association, Mr. Riley described the newly-hatched larva of some of our common blister-beetles; but all attempts to trace their habits had proved futile both in this and other countries until 1877, when he discovered that they preyed on the eggs of locusts (*Acrididæ*). In a paper published in the last volume of the Transactions of the Academy of Sciences, of St. Louis, the life-history of several of our common blister-beetles is traced. The present paper gives a brief résumé of the facts there recorded, showing that the beetles belonging to the genera *Epicauta* and *Macrobasis* go through the same curious hypermetamorphoses as do other species of the family *Meliodæ*, and especially as *Melæ* and *Sitaris* were already known to do. The larva hatches as an active, pale-brown, long-legged creature, termed triangular on account of the three-clawed tarsus. It then changes to what Mr. Riley calls the *Carabidoid* stage, in which it is white, less active and fleshy; then to what he calls the *Scarabæidoid* stage, in which it is still more degraded and clumsy; then hardens to what he calls the *coarctate larval* stage, in which it is perfectly helpless and resembles the *puparium* of many Diptera; then to the final larval stage, in which it is again white and soft and more or less active; then to the true pupa state; and, finally, to the beetle; existing, thus, in eight distinct states, (including the egg,) instead of the four in which ordinary insects occur.

The paper is principally devoted, however, to the life history of a very anomalous, wingless genus of this family, the *Hornia Minutipennis* of Riley. This insect is degraded and subterranean, and was found in the cells of a common mason bee, the *Anthophora abrupta*, Say. Its life-history, which was not known at the time the species was described, has been completely made out by

Mr. Riley the present summer. The eggs which are laid loosely in the burrows of the bee hatch during the early part of June. The triungulin is extremely active, and, in all essential characters, very similar to that of *Sitaris*, one species of which, in Europe, likewise develops in the cells of *Anthophora*. By means of its tarsal claws and of a pair of pre-anal spinnerets and claspers, it holds on very tenaciously to the hairs of the bee, and is carried on the same into the bee-burrow. When the bee-egg is laid, and before the cell is capped over, this triungulin disengages itself from the bee and at once pounces upon the bee-egg. After having sucked the contents of this last it throws off the triungulin skin and assumes the *carabidoid* stage; thereafter feeds upon the honey-paste stored by the bee, and, within the cell, goes through all the hypermetamorphoses characteristic of the family. All the latter stages, however, take place within the puffed skin of the *scarabæidoid* larva, the *coarctate* larva being well separated therefrom, but the third or final larva having such a delicate skin that it is not easily separated from this last when shed. There is but one brood annually; the pupa state being attained in August, and the beetle maturing all its parts during the autumn, and lying within its numerous coverings until the following May.

The paper contains some interesting details as to the effect of rain both on the bee larva and the *Hornia* larva; on the vicissitudes that befall the triungulin, its fratricidal propensities when two or more are inclosed in the same cell, and on its adaptability to food-supply.

ON THE LARVAL CHARACTERISTICS OF CORYDALUS AND CHAULIODES AND ON THE DEVELOPMENT OF CORYDALUS CORNUTUS.

BY PROF. C. V. RILEY.

(*Abstract.*)

The paper relates to the development of one of the most singular and interesting of North American insects—the largest of the order Neuroptera. In its perfect state this insect is a great, clumsy, nocturnal fly, popularly called Hellgrammite, and characterized by the jaws of the male being converted into a pair of long, curved, cylindrical and tapering prehensile organs, like the finger of a grain-cradle. In the larva state it is aquatic and much esteemed as fish-bait by fishermen, who call it a "crawler," "dobson," etc. Indeed, one of the most popular artificial fish-baits is a patent india-rubber imitation of it. This larva is very peculiar in having in its latter stages three distinct sets of breathing organs, viz: the ordinary spiracles, a lateral series of long, single bronchial filaments, and a ventral series of spongy branchiæ, composed of numerous branching and tractile filaments. The eggs of this insect are laid to the number of about three thousand in curious masses on the leaves and branches of trees, or upon any other object overhanging water, and were first described by Prof. Riley at the Buffalo (1876) meeting of the Association. After comparing the eggs with those in the female abdomen, and the newly hatched with the mature larva, he felt quite certain as

to the parentage of the curious eggs. Yet the newly hatched larva which he described differed from the mature larva in lacking the ventral branchiæ, resembling in this respect the mature form of another aquatic larva of an allied genus (*Chauliodes*), and as some leading entomologists believed that the eggs described by Prof. Riley might belong to this last genus, further evidence as to the real nature of said eggs was desirable. The paper presents this evidence and confirms the previous determination. . The *Corydalus* larva is traced through its stages of growth and then compared with that of *Chauliodes*. Several interesting scientific facts are brought out. The larva undergoes about six molts. The double nature of the thoracic tracheæ in *Corydalus* appears in the first larval stage, and the branchial nature of the lateral filaments is proved by the tracheæ leading to their tips. The ventral branchiæ first appear in the second stage (after first molt) and from three main stems each with bifurcate or trifurcate filaments. The branching filaments become more and more numerous and complex with each molt. The tracheæ also lead more and more strongly to these ventral branchiæ and less strongly to the lateral ones, with age. The stigmata are obsolete in the first three stages and in the fourth are only clearly distinguishable on the four or five larger abdominal joints, being still obsolete on the terminal ones.

The motion of the larva is invariably backwards. When newly hatched it moves actively about in the water by sudden sweeps of the abdomen beneath, very much as a lobster is known to do; and even, when full grown, a somewhat similar motion is employed in swimming. In the water a constant motion of the ventral branchial tufts is kept up, the main stem being first moved quickly backward and upward so as to bring the whole tuft close to the body, the filaments of which it is compo ed being then closely appressed to each other. The main stem is then brought more slowly down in the opposite direction, when the filaments spread and enlarge the whole to its utmost. In pure water the motion occurs about once a second; as the water becomes impure the motion becomes more rapid and the larva issues from the water as soon as posssible, being able to live out of water for several days even when only a few months old. Well developed ova are found even in the larva when only two-thirds grown.

The paper gives detailed comparative descriptions of the *Corydalus* and the *Chauliodes* larvæ. This last may always be distinguished from the former by having a smooth and unarmed skin; that of *Corydalus* has a skin roughened with granulations and capitate or clavate projections, overlooked by previous describers, the little points being visible even in the first stage, at which time they are less capitate. The *Chauliodes* larva has the last pair of spiracles on the tips of a pair of contractile filaments described as setæ by Walsh who failed to apprehend their real nature and wrongly described the *Chauliodes* larva as having one pair of spiracles less and one abdominal joint less than that of *Corydalus*, whereas both larvæ have the same number of joints and spiracles and both possess the rudimentary mesothoracic spiracle, which Prof. Riley finds more common in insects than is genrally supposed. In other structural respects as well as in the habits and transformations the two larvæ greatly resemble each other. The eggs of

Chauliodes have a longer tubercle or stem on the top, and are not covered with white albuminous material as are those of *Corydalus*. Prof. Riley has obtained large additional numbers of the egg masses of the latter the present summer, finding them not only on the leaves as described in his former paper, but on the stems of different trees, as well as on rocks overhanging water. He has had as many as twenty egg masses on a single maple leaf, both sides of the leaf being completely plastered up by them: and as a large number of these masses will generally be found in some one particular locality, or on a few branches of the same tree, the assumption is that the females congregate for purposes of ovipositson. The white, albuminous substance covering these eggs shows by analysis that it has all the physical properties of wax.

In the afternoon little or nothing was done, except that the committees of the sections met and arranged for to-day's papers.

In the evening a large number of members and citizens assembled in the chapel to listen to the address by the retiring President of the Association, of which we give the greater part:

THE COURSE OF NATURE.

BY PROF. SIMON NEWCOMB, WASHINGTON, D. C.

After announcing that he appeared as a peacemaker between the scientific investigators of the material manifestations of nature on the one side and the philosophers and theologians on the other, respecting the true theory of the course of nature, he proceeded at length to explain away the apparent differences between scientists and theologians by asserting that Science only concerns itself with phenomena and the relations which affect them, and does not take account of any questions which do not in some way admit of being brought to the test of observation, while the theologian looks upon the doctrines he has been taught as something, the truth of which is essential to the welfare of humanity, his idea of truth being symbolized in the pure marble statue, which must be protected from contact with profane hands, and whose value arises from its beauty of form and the excellence of the ideas which it embodies. He therefore looks upon those who attack it with feelings not unlike those of the keeper of the statue upon a chemist who refuses to see anything in the statue except a lump of carbonate of calcium of peculiar form, and who wants to handle it, weigh it, determine its specific gravity and its cohesive power, and test its substance with acid. The corresponding idea of the scientific investigator is symbolized by the iron-clad turret, which can not be accepted until it has proved its invulnerability. Instead, therefore, of being protected from violence as if it were a product of the fine arts, violence is invited. Its weak points are sought out by eyes intent on discovering them, and are exposed to the fire of every logical weapon which can be brought to bear upon them.

After still further elaborating this idea and declaring that the true scientific investigator tests every question under consideration by a more or less long and

painful examination, putting everything that can be found to militate in favor of it into one scale and everything that can be found to militate against it in the other and only deciding by the preponderance of evidence, he proceeds to the discussion of the subject, as follows :

Let us now approach our main theme, the course of visible nature. Let me again remind you that of the two universes, the seen and the unseen, I am only going to speak of the former. We find ourselves placed in this world in the midst of a vast theater of activity. We see an atmosphere agitated by storms; great masses of water rising in the air to form clouds, and, after falling to the earth, flowing as mighty rivers to the ocean; countless forms of vegetation rising from the earth and then returning to it; a sun vivifying one and perhaps more planets with its heat; an infinitude of chemical changes going on around us; countless stars moving through space with velocities which transcend all our conceptions. To all appearances, these operations have been going on for millions of ages past, and may continue for millions of ages to come. As the thinking man contemplates them he is led irresistibly to the conclusion that they do not go on at random, but that they were joined by connecting links, or are in some way the product of knowable causes. From his earliest infancy he sees connections between them which enable him to foresee results. He finds that fire burns, that the sun warms, that food satisfies his hunger and that heavy bodies fall with a certainty that shows the forces at play to be invariable in their action. To penetrate the mystery in which these forces are enshrouded, he exerted the efforts of his intellect from its first dawn in ages now forgotten until the present time. What general conclusion has he reached?

From the earliest times at which man began to think, two modes of explaining the operations of Nature have presented themselves to his attention. These modes are sometimes designated as the teleological and the mechanical.

The teleological explanation of Nature pre-supposes that her operations are akin to human action, insomuch as they are under the control of, and directed by one or more intelligent beings having certain ends in view; that the events are so diverted as to compass these ends; and, finally, that the relation of the events to the ends admits of being discovered by observation and study. This last condition is a very important one because without it the teleological explanation of the cause of Nature would not be a scientific one. The doctrine that the Author of Nature has certain ends in view, and directs the whole course of events so as to bring them about, will not enable us to explain and predict the events unless we know what those ends are. But, as I have already said, the test of scientific advance is the power of foresight—of foreseeing what result any combition of circumstances will lead to. If we always had to wait for the result, and could then only say, I know this is the result which was intended because it has happened, no actual foresight would be possible; and however excellent the doctrine might be as a theological one, it would not admit of being tested by observation and experiment, and the question of its truth would, therefore, not admit of being settled by scientific investigation.

It must be well understood that the teleological theory of nature, or, as it is now familiarly called, the explanation of natural phenomena by design, has two distinct forms, the scientific and the theological. These forms are not antagonistic ones; one is held by scientific men, and the other by theologians; for, as you may well know, the scientific form is the one in which scientific men almost universally reject the teleological theory, while they have nothing to say against the other forms. The forms refer only to the fields to which the theory may belong, the scientific and the theological. The distinction turns on whether we suppose the ends which the Creator has in view to be discoverable by scientific investigation or to be inscrutable. Only in the former case have we, as scientific investigators, anything to do with the question. Now, as we shall more fully see hereafter, the number of ends supposed to be scrutable has constantly diminished, and the theory of design on the scientific side has narrowed its scope in proportion. The only scrutable end which nature is now supposed to have in view, is the good of living creatures, and especially of man, and even in this field we know so little about what is good for us individually, that we here have only a slight clew to the result. On the other hand, the number of events which directly or indirectly interest us is so great that thls slight clew may be supposed to lead to many knowable results, if we once admit the theory.

The other explanation of nature is the mechanical one. It assumes that her processes go on in accordance with certain laws which admit of being fully comprehended by the human mind so far as their effects are concerned. Each state of things is the effect of the state which immediately precedes it, and the cause of that which immediately follows it. The cause of nature is thus considered as an endless chain, of which the work of science consists in making out the forms of the links, and the modes in which they are connected. In this investigation we have to be governed by two things—the general laws of nature, as they are familiarly called and the facts or circumstances which determine the operation of these laws. This distinction is most clearly seen in human laws. Thou shalt not steal, is a law; that John has stolen, is a fact. The combined result of the law and the fact is that John is locked up in jail. So, that all bodies near the earth gravitate toward it with a force directly as their mass, and inversely as the square of their distance, from its center, is a universal law of nature. The Niagara river and the precipice are facts, and the cataract is the result.

But the general explanation of the course of nature, on the mechanical theory, is not of this kind, because the laws of nature do not act singly, but in combination, so that the result of each is modified by the action of all the others which come into play. The law of gravitation is not that all bodies must fall, but only that they tend to fall, and, therefore, will fall unless held up by some sufficient opposing force. So long as I support this weight in my hand it does not fall, because the force of gravitation and the resistance of my hand neutralize each other. But the instant I let go, the weight drops, according to a certain law known as that of uniformly accelerated velocity.

The doctrine I am endeavoring to elucidate is this: Knowing a few simple

laws of nature, of which gravitation is one; knowing also the arrangement of material things within the field of investigation; that is, knowing the facts, we can predict with unerring certainty what the result will be; or, if we cannot predict it, it is not because of any quality of the thing itself, but only because of the insufficiency of our powers. Moreover, these results will be, as it were, another layer of facts, from which it is possible to predict new results to follow them, and so on without limit, unless some facts from without intervene to change the cause. If we include the whole of nature in our field, no outside facts can come in, and her course, therefore, admits of being predicted with entire certainty from beginning to end.

Now, the point which I wish to bring to your attention, is the revolution which modern science has brought to pass, in the opinions of mankind, respecting the relations of the two classes of causes or supposed causes which I have described. That all events could be explained on teleological principles, it is not likely that any one ever supposed. That the falling of heavy bodies, the running of rivers, the changes of seasons and the revolutions of the heavens were all in accordance with mechanical laws, at least so far as the phenomena are concerned, no one ever knowingly denied. But it was thought that the action of these causes was from time to time modified by the introduction of causes of the teleological class, just as a rock might be kept from falling by the force of cohesion. The general rule has been that the more ignorant the age the more minute and immediate was supposed to be the action of those beings who were modifying the course of nature in order to compass their ends.

As illustrating this I might commence with the age of image worship when the fate of the individual was supposed to be at the mercy of certain spiritual entities, symbolized by forms of wood, stone or wax. But leaving out of consideration ideas so different from those which prevail among us, let us come nearer home. It is not many generations since men who knew that the regular course of nature went on in accordance with mechanical laws believed, nevertheless, that occurrences of a terrific or extraordinary character were specially brought about to compass some end of Providence. Not only so, but, what is most essential to our theme, this end was supposed to be a scrutable one. The motions of stars and planets had gone on from age to age until no new aspect of them inspired alarm. But a comet was looked upon as a messenger specially sent to give warning of a coming calamity. The scrutable end was, in this case, the warning of mankind.

Ordinary cases of sickness and accident, whatever their result, are always looked upon as a part of the regular course of events. But it is not many centuries since the pestilence was believed to be specially sent by heaven to punish mankind for their wickedness. Punishment and terror were here the ends which Providence was supposed to have in view. The regular daily breezes and showers were supposed to be the result of natural laws. But these laws were not supposed to be entirely adequate to the production of the tornado, which was again a special messenger, and they were suspended, or their action was modified in time of extreme drought, threatening mankind with famine.

These special messengers of heaven, have, one by one, yoked themselves to the car of natural law, so that I think I can hardly be wrong in saying that the supremacy of mechanical law, and its adequacy to account for the whole course of nature as we see it going on before us, is now the almost universal opinion of educated men. This revolution in human thought is, perhaps, clearly brought out in the different view we now take of certain religious observances introduced by our ancestors, whose ideas would now be considered as approaching the irreverent. Take, for example, the prayers for the right kind of weather, which we find in our prayer books. When they were first composed and inserted, their object was a purely practical one. As the farmers now sometimes fire off cannon to make the black cloud break and discharge its contents upon the parched field, so the prayers were to be offered up in order that the aqueous vapor in the air might be made to condense and fall. That a much more exalted view of prayer than this is now taken by the more enlightened portion of the religious world, I think we have every reason to believe.

Although we can hardly entertain a serious doubt that the mechanical theory of natural operation, or, as it is sometimes called, the doctrine of the uniformity of nature, is generally acquiesced in by the mature thought of intelligent Christendom, yet objections are frequently made to it because it seems to run counter to some of our most cherished ideas. If it were not paradoxical to make the assertion, it might be said that we hold, or at least express entirely inconsistent views on the subject. The fact is we are pupils in two opposing schools which are, in a certain sense, antagonistic, one of which we cannot, and the other of which we will not give up. In one of these schools the chief teachers are observation and experience. All sentiment and emotion are banished from its curriculum, which admits only the hard realities of the outer world. The older we grow the more we see and hear of this school, and the more unreservedly we accept its teachings. It tells us that the whole course of nature takes place in accordance with certain laws capable of expression in mathematical language; that these laws act with more than an iron rigor, and without any regard to consequences; that they are deaf to prayer and entreaty, and know no such thing as sympathy or remorse; that if we would succeed we must study them and so govern ourselves that their action shall enure to our benefit.

The other school is that of sympathy, emotion and religious faith. In it, as children, we receive our first teachings. It shows us ourselves placed, as it were, in a forest of mystery, surrounded by forms over which we have no control, and able to penetrate so little into the surrounding darkness that we cannot tell what shall happen to us on the morrow. It has, in all ages, peopled the thickets with invisible beings having an interest in our welfare or our injury, or with providential interferences designed to compass each, of which we in advance, have no conception. Its teachings are nearest and most welcome in times of affliction and fear. Its objections to the teachings of the other school are heard far and wide through the land. Notwithstanding the number of forms which these objections

take, their essence may be condensed into a very few sentences. The following will probably be accepted as a fair rendering of their substance:

You take a contracted and unphilosophical view of nature when you say that the world is governed by inexorable laws. These laws are not governors but only the instruments of government by which the real Governor executes His purposes. With them, but without subverting them or violating them, he can reward or punish, bring on prosperity or call down disaster according to the dictates of his sovereign will. The child and the peasant call the thunder the voice of God. The modern philosopher attempts to correct them by showing that it is the product of evaporation and of atmospheric electricity. But the view of the child is really the more correct of the two, because he ascends at once to the first cause and thus sees farther than the philosopher who corrects him, because the latter stops short at the immediate or secondary cause without even trying to raise his eyes to the higher source of power. I think I am not far wrong in giving this as the substance of the most cogent objections which may be anticipated in any quarter against the mechanical theory of the course of nature.

Now, if these views referred only to inscrutable first causes of things, or to the intelligent but invisible substratum which underlies the whole course of nature, we should have no occasion to discuss them, because they would lie outside the field I have assigned as that of our contemplation at the present time, and which I have sought to describe as the field of phenomena. The doctrines that all things go on in exact accordance with the will of the Creator; that he has certain ends which the laws of nature are designed to bring about, and that an intelligent cause lies behind the whole universe of phenomena, are of a class which science has no occasion whatever to dispute. If it were made clearly to appear that the field of the teachings in question was thus limited, and was entirely distinct from that of phenomena, with which alone science is occupied, there would be no occasion for dispute between the two schools. I have no disposition to throw a single stone across what I consider the sacred boundary line, nor to enter a field which I am by natural and acquired habits of thought unfitted to cultivate. As men of science, let us by no means attempt to penetrate a region in which the eye of science can see nothing but darkness. If we thus subject ourselves to the imputation of being "of the earth, earthy," we may console ourselves that our edifice is firm and durable, because it does not seek to rise into regions of serener air, nor to rear its dome above the clouds.

I can hardly be mistaken in saying that the objections to the mechanical theory of nature which I have just tried to formulate are not always confined to the field of inscrutable first causes. There is a part of the boundary line over which the stones are flying very thickly. While some of the combatants may profess to make no attack on the doctrine of the uniformity of natural law, I cannot but think that these professions often arise from a misapprehension of the scientific side of the question.

Indeed, I must confess that I have met with a difficulty from my inability to form a clear idea of the views really entertained by the school now under consid-

eration. I have made a somewhat careful study of some of the most elaborate works of the writers of the theological school devoted to this very topic, and I have left them without being able to decide in my own mind whether the writers do or do not hold unreservedly to the mechanical theory of the cause of nature. That nearly all intelligent men do not hold to this theory, at least so far as the present time and dispensation are concerned we have abundant reason for believing. Nor is there, even among advanced theologians, any lack of profession of a belief in the uniformity and supremacy of the laws of nature.

But, when thinkers of the other school maintain the doctrine, and trace it to its logical consequences, undisguised by sentimental language or figure of speech, they are met with criticism which I can account for only by supposing that the theologian understands by laws of nature something different from what is understood by the man of science. Let us try to condense the questions at issue into the smallest possible space. The scientific philosopher maintains that the natural course of events goes on in invariable accordance with what I have described as the mechanical theory of nature. He asks the theologian in the words of Pope—

"Thinkest thou like some weak Prince the eternal cause
Prove for his favorites to reverse his laws?
Shall burning Ætna, if a sage requires,
Forget to thunder and recall her fires?
On air or sea new motions be impress'd,
O blameless Bethel, to relieve thy breast?
When the loose mountain trembles from on high
Shall gravitation cease if you go by?
Or some old temple, nodding to its fall,
For Chartres' head reserve the hanging wall?"

To all these questions the other answers no, and thus all occasion for dispute ought to end. But it does not end, by any means, for he proceeds to criticise the views of the questioner on the ground of their narrowness, and to inform him that the Creator can (and, by implication that he does,) so arrange things that any result he may wish shall be brought about by the action of natural laws themselves. "We do not expect Ætna to recall her fires when a sage is near; or the air and ocean to acquire new motions to preserve a saint from danger." * * * Should these individuals not be rushing recklessly against the known laws of heaven, or should it be the will of God to preserve them, it will be found that provision has been made for their escape, and that not through the powers of nature disobeying their own laws, but through other powers in nature opportunely interposing to stop, to turn aside, or otherwise to modify their operation.

Now, always supposing that such remarks as these are intended to apply to the domain of sight, hearing and understanding, they differ fundamentally from the scientific theory in their view of what constitutes the laws of nature. The school seems to look upon causes and effects in nature as belonging to two different classes of things. They see an immense collection of causes, to each of which the appropriate effect is tied. So long as the cause is followed by its effect

the laws of nature are satisfied. So, if the Ruler wants to reward, punish, kill or rescue, He has only to bring into operation the appropriate cause at the proper moment; the natural effect follows and His will is executed without any violation of the laws of nature. I am not sure that this is an exact statement of the views to which I refer, but it is the best I can gather from the study of the forms in which they have found expression.

Supposing this to be the view really entertained, it is essentially different from that held by the scientific philosophy. The course of Nature, as it presents itself to the eye of science, is not a collection of isolated causes, each with its effect attached to it, but it is rather to be symbolized by a chain in which each link is connected with the link which precedes it and with the one which follows it. At each moment of time the state of the universe is the effect of the state which immediately preceded it and the cause of the state which immediately follows. There are no such things as distinct causes and effects, but only laws of progress, which connect the successive links of the seemingly endless chain.

As an illustration of this, let us take the falling of the rock. To the mere observer there is no evident reason why it should fall at one time rather than another; he may therefore feel that there is room for speculation as to the cause which made it fall at the exact moment it did. But science teaches that it will fall at the very moment when the cohesive attraction which binds it to the mountain behind becomes less than the weight of the rock. We might suppose a power so to adjust the causes which effect the cohesion that the rock shall fall at some desired moment. But any such adjustment would be as complete a subversion of natural law as if the power should hold the rock up after it had begun to fall. The natural processes by which the cohesion of the rock is slowly diminished, though largely hidden from our view, are governed by laws as precise in their action as those which regulate the motion of the planets. The water which falls from the clouds slowly percolates through the ground and enters a crack in the supporting mass. It wears it away at a rate dependent upon the solubility of the material and the quantity of water which falls. A constant but certain molecular action goes on without ceasing between each molecule of water and each molecule of rock. The strength of the latter is thus weakened according to some law admitting of precise mathematical statement. Thus, a mind possessed of sufficient mathematical ability, knowing how much water runs over the rock from time, to time, and knowing also the laws of molecular action between the rock and the water, could determine, long in advance, the very moment at which the rock would fall.

Going back another step, we see that the quantity of water which runs over the rock depends on antecedent circumstances in the same way, namely, upon the quantity of the rainfall and the arrangement of the crevices in the ground. However the latter may have been produced, the cause is still another link in the endless chain which we can trace back to preceeding links as far as we please. Equally is the rainfall a fixed element determined by the course of the winds and the amount of moisture which they carry. Thus we have a network of causes, too complicated for the human mind to trace in detail, but which the philosophy of

science teaches us act with mathematical certainty. No tempering, modifying, or adjusting action comes in at any stage of the process, so far as we can see; if we admit such action we have to keep placing it farther back as our knowledge increases.

Now, there is one feature of these causes, the admission or rejection of which constitutes the main point of difference between the two schools of thought, which I have before indicated. All are agreed that the course of nature is determined by what we may call causes or laws, but all are not agreed as to the scope of action of these laws. The great and distinguishing feature which the school of sciences recognizes, and which the other school does not recognize, is that all the laws of nature act without any scrutable regard to consequences. I qualify my statement by the word scrutable, because it is entirely outside the pale of scientific research to speculate upon possible inscrutable ends in nature. This being a subject on which the man of science, speaking as such, can affirm nothing, so he can deny nothing. Having found that no trace of regard for consequences can be seen in the mode of action of the laws which he investigates, but that the whole course of things, so far as his eye can penetrate, may be explained and predicted without supposing any such regard, the demands of science are satisfied, and he must there stop.

Let me illustrate this by going over the train of thought which has just occupied us, in the opposite direction, starting from the rainfall, and tracing the succession of causes to the fall of the rock. The spot at which each drop of rain shall fall is determined by antecedent conditions entirely, by gravitation and the winds. The drop neither seeks nor avoids the crevices, never asks in any way what shall be its destiny after it reaches the ground. It strikes the ground wherever gravity and the winds bring it, percolates through the soil according to the law of least resistance, and dissolves the rock according to the laws of chemical affinity, without any respect to the consequences, immediate or remote. At length a moment arrives at which the cohesive force of the rock becomes less than the weight which urges it downward. This movement is by antecedent circumstances, such as the solubility of the rock and the amount of water which percolates over it. At that very moment the rock begins to fall. It falls sixteen feet the first second, three times that distance the next, and so on, according to the mathematical law of falling bodies, without any respect to the lovely character of the beings it may destroy or the disasters with which it may crush the fondest hopes of men. The region may be the wilderness; the passer-by may be a babe in its nurse's arms, an angel of charity fulfilling her mission of good will, or a murderer aiming the deadly blow at his victim, but under no circumstances can we see that these conditions in any way affect the chain of causes which lead to the falling of the rock, or cause it to wait a moment or swerve a hair's breadth from its inevitable course.

According to the theory of the course of nature, which I am trying to elucidate, the chain of causes which we have described, each cause acting according to antecedent conditions, but without any regard to consequences, is the type of the whole course of inanimate nature, as far in space as the telescope can pene-

trate, and as far back in time as the geological record can be deciphered. An essential feature of the theory is that the laws which connect the several links of the chain, and thus determine the progress of events, do not possess that character of inscrutability which belongs to the decrees of Providence, but are capable, so far as their sensible manifestations are concerned, of being completely grasped by the human intellect and expressed in scientific language. Without this the theory would have no practical bearing whatever, because, to say that the course of events is fixed, but by laws which we can never grasp, would give us no clew to learning what that course shall be, and would be equivalent to telling us that it is enshrouded in the same impenetrable mystery with first causes. A very important feature of the progress of science is found in the constant resolution of the laws of Nature into more simple and elementary ones, until we reach principles so simple that it is impossible to analyze them farther. Let us take as an instance of this, the laws of the celestial motions. When Kepler discovered that the planets moved round the sun in ellipses, having the sun in one focus, he found what were for his time simple and elementary laws. They were entirely comprehensible, admitting of being expressed in mathematical language. They enabled him to predict the motions of the planets, and so far as the intellect of the time could penetrate, they could not be resolved into more simple expressions.

But when Newton appeared upon the scene he showed that these and other laws could be expressed in the simple and comprehensive form of gravitation of every particle of matter toward every other particle with a force inversely as the square of the distance which separates them. All the laws of planetary motion which had before been discovered were shown to be reducible to this one simple law, combined with certain facts respecting the directions and velocity of the planetary motions. The most essential of these facts is that the velocities of the planets in their orbits are such that their orbits, under the influences of the sun's gravitation, are nearly circular.

By this grand generalization Newton reduced the laws of the celestial motions to a form so elementary, simple and comprehensive that no further reduction seems possible in our present state of knowledge. Attempts have been made to show that gravitation is itself the result of discoverable causes, but they appear to me entirely unphilosophical, since the causes into which they would resolve gravitation are more complex than gravitation itself. But for our present purpose it is not necessary to concern ourselves whether gravitation may arise from some more subtle principle as yet undiscovered. The point which I wish you to grasp is the entire comprehensibility of the law as it now stands. There is no mystery surrounding it. When I say that any body left unsupported will fall toward the center of the earth until it meets with the earth itself or some other obstacle to its further fall, you know exactly what I mean and what are the results of the law which I enunciate. In a certain sense we might say that the laws of nature are simply *general* facts distinguished from special facts by their dependence upon certain antecedent conditions. Considered as such there can never be any doubt as to their meaning or results. There is no profound philosophy involved in their

action or expression any more than there is in such statements as that all unsupported bodies fall toward the center of the earth; that gunpowder, when touched by fire, suddenly changes to an incandescent gas; that water, at ordinary pressure, changes to steam at a temperature of 212°.

Now, scientific investigators are earnestly endeavoring, each in his own sphere, to do for the whole of nature what Newton did for the laws of planetary motion; to find and announce the elementary principles which connect all the links of the endless chain which symbolizes her course. The student of chemistry can not doubt that the innumerable properties of the various compounds which he studies arise from the play of certain attractive and repulsive forces among the elementary molecules of the matter of which these compounds are formed. Could he only learn the law according to which these forces act, chemistry might become very largely a deductive science, and the properties of compounds might be predicted in advance as the astronomer predicts the conjunctions of the planets. The idea now entertained by those who see farthest in this direction is that all the physical properties of matter depend upon and may be reduced to certain attractive and repulsive forces acting among the ultimate atoms of which matter is composed.

It may also be supposed that all the operations of the vital organism, both in men and animals, depend, in the same way, upon molecular forces among the atoms which make up the organism. The operation of forces unknown to chemistry must, indeed, be presupposed, but there is no reason to suppose that these forces are less simple than chemical ones. Some would even go so far as to explain the facts of consciousness in this way. The philosophy of this explanation belongs, however, to another department of thought—that of scientific materialism—into which we cannot at present enter.

The most startling attempts in the direction I have indicated are those which are designed to show that those wonderful adaptations which we see in the structure of living animals, and which in former times were attributed to design, are really the result of natural laws, acting with the same disregard to consequences which we see in the falling rock. The philosophy of Darwinism and the theory of evolution, will be at once brought to your mind as forming the modern system of explanation tending to this result. On these theories the eye was not made in order to see, nor the ear in order to hear, nor are the numberless adaptations of animated beings to the conditions which surround them, in any way the product of design. Absurd as this theory appears at the first glance, and great as is the anxiety to secure its rejection, the question of its truth is to be settled only by a careful scientific study of the facts of nature and the laws of hereditary descent. The principle which is to aid in its settlement is universally admitted in quarters where it it is fully understood. We are not to call in a supernatural cause to account for a result which could have been produced by the action of the known laws of nature. The question then is whether these laws of hereditary descent and of natural selection are adequate to account for the gradual growth of such organs as the hand, the eye and the ear, and for all the adaptations which we see in na-

ture. If they are, it would be idle to call in any other cause, except we place it behind the laws, and if we place it behind those laws we must equally place it behind all others. Of course, such a cause lies beyond the field of sight and does not, therefore, belong to scientific observation. Granting the theory, then, so far the eye of science can penetrate, the whole result is brought about by laws acting in seemingly blind disregard of consequences.

Let us now turn once more to the theory of scrutable design, which supposes at least the occasional action of causes which the human intellect can perceive to have been intended to produce certain effects, such as the salvation of the righteous, the punishment of the wicked, the warning of the indifferent or the preservation of the race. Studying this theory from the purely scientific standpoint in all the varying forms in which history presents it, we see its distinguishing feature to be the idea of causes acting so as to bring about certain results.

(CONTINUED IN OCTOBER NUMBER.)

The third day's meeting (Friday) was made one of the most interesting of the session by the demonstration by Prof. Edison of his various inventions and discoveries, the paper read by Prof. Riley on "The Philosophy of the Movements of the Rocky Mountain Locust," and the descriptions by Prof. Barker of his observations of the late eclipse of the sun.

Among other matters of miscellaneous business Prof. Bolton reported from the committee to memorialize Congress in relation to meteorological researches. The report recommended that the committee be continued, and that Mr. Osborne, of Washington, be added to the committee, and that Prof. Loomis be requested to take the chair. Report adopted.

Profs. Newcomb and Baird, of Washington, and Prof. Meyer, of Hoboken, were appointed by the chair a committee to draft a eulogy upon Prof. Henry, as ex-President of the Association.

Prof. Putnam, the Permanent Secretary, announced that Prof. Wm. B. Rodgers had given a second donation of $100 to the Association. He was, on motion, made a life member.

The Standing Committee recommended that article 35 of the Constitution be repealed, in order to enable life members to receive the publications of the Association free. Laid over for a year.

Adjourned.

After the meeting of Section A, Prof. Barker introduced Prof. T. A. Edison, who was very warmly received by the audience and members present, and heartily welcomed by Vice-President Thurston in a very complimentary address, after which he proceeded to explain in a simple and lucid manner, aided by diagrams, the use of the Tasimeter in measuring the heat of the stars and the sun's corona. He also explained by means of diagrams on the board his new Volameter. It is useless to undertake to give the substance of these remarks in the absence of the diagrams.

After Mr. Edison had finished, two papers were read by Prof. Barker. The first of these dealt with the

SPECTRUM OF THE CORONA,

As seen by himself at Rawlins, W. T., on the occasion of the late total eclipse of the sun. Observations were made with a 4-sec. telescope, by Jones, of London, and a direct vision spectroscope, by Merz, of Munich, having 5 prisms, equal to two prisms of heavy glass, and working with a broken joint. After describing his apparatus, Mr. Barker said: "I moved the green portion of the spectrum into the field, but no line was visible. I then varied the width of my slit, opening and shutting it so as to see if the line of 1474 was visible, but although the slit was narrowed until the Fraunhofer lines were distinct and sharp, showing the instrument was in perfect adjustment, yet no 1474 line could be detected in the spectrum. I then moved the slit, or rather moved the telescope—for the telescope moved upon a center—I moved the observing telescope of the spectroscope over the spectrum three times from the extreme red to the extreme violet, but was entirely unable to observe any bright line whatever throughout the whole length of the spectrum. Prof. Draper observed the eclipse with a telescope of two inches aperture, in the top of which was placed between the objective and the eye-piece a prism of 45°, carrying a clear two inch beam. Using the prism thus in the telescope between the objective and the eye-piece, of course the appearance to him would have been of as many images of the corona as there were different refrangibilities in its light, and he supposed he would get two if not three rings. But the appearance was absolutely continuous. The spectrum was as clear and sharp and smooth as if he had used the whole sun. He took a first glance at that, and then at my request came to look through my spectroscope of higher power, moved it over the whole spectrum and said that the results agreed, and that the spectrum was continuous in my instrument, as in his. I then moved the slit over various portions of the sun's edge and placed it both longertially and radially. The observations of this line and spectrum were of course exceeding rapid, as must have been the case, and yet with no position of the slit that I could get was any light line whatever observed, except for an instant, when the slit crossed a small prominence observed upon the upper limb of the sun. The results, then, of our spectroscopic examination at that altitude, 7,100 feet, coincided with the results obtained by the photograph. The photographs of the defraction spectrum obtained at the same time by Prof. Draper, are absolutely continuous without even shading. Of course the 1474 line is out of the question in this case, because that line is in the green, and of course the green part of the spectrum is not photographically active, but no lines were obtained on the blue part of the spectrum by photography.

I am the more reluctant to make a very strong statement in regard to the absence of the line 1474, because I understand Prof. Young himself saw that line. I entirely defer to him. I can't exactly say that I don't believe I saw it, if he did, for that is not the business of a scientific man, but I am sorry not to see him here so I could ask him where he saw it, and for how long a time. A man of his experience and standing in solar physics, may—from the fact he has seen several eclipses before—have known about the adjustment and about the

position necessary to secure a good result. I simply state that with the means I used it was quite impossible for me to get a single bright line in the spectrum of the corona "

Mr. Barker's next paper was on "A New Method of Determining the Pitch of a Tuning Fork." At the end of one arm of the fork is placed an induction coil, through which passes a voltaic current, not strong enough to at all disturb the vibrations of the fork. The current induced by the vibrations of the fork operate a telephonic desk, with a stud-pin engaging with a cylinder covered with chemical paper. The tellurium point of the recording pin by contact with the ferrous-cyanide paper, leaves a black dot for each vibration registered. By comparing the register of vibrations with the register of seconds of time, the rate of vibration is arrived at with mathematical accuracy.

The following papers were read by Prof. J. W. Osborne: On the construction of a Sensitive Wind-vane. On Wind-vane Rotations. The Importance of Meteorological Observations in Vertical Section of the Atmosphere, with the suggestion of means for their systematic accomplishment.

The last paper in this section was "Magnetic Determinations in Missouri," by Prof. Francis E. Nipher.

PROCEEDINGS OF SECTION A.

Monday.—The proceedings in Section A were very interesting. Prof. J. W. Osborne made an address on "The Importance of Meteorological Observations in Vertical Sections of the Atmosphere, with the Suggestion of Means for their Systematic Accomplishment." Prof. Osborne pointed out the impossibility of taking vertical atmospheric observations with the present means, as the buildings of the observatories necessarily interfered with the currents. He did not think a balloon would meet the exigency, as it was impossible to secure it in a perfectly stationary position. He recommended the building by the National Government of a high tower, from two hundred to four hundred feet, on a prairie, where it would be away from disturbing influences.

Prof. Barker, on behalf of Mr. Edison, made an

EXLANATION OF THE CARBON BUTTON.

In his opinion, he said, the carbon button, the invention of Mr. Edison, was one of the most important discoveries, if not the most important discovery, ever made in this country. It was the nucleus of a whole crowd of inventions of Mr. Edison. It arose out of a long series of experiments, and had been brought to perfection only within the present year. It consists simply of a certain variety of lamp-black, which is compressed by a screw press in steel dies, to form a disk about the sixteenth of an inch long and over half an inch in diameter. In experimenting all forms and varieties of carbon and all conditions of condensation were used. It was found that the smoke of a mixture of kerosene oil and petroleum naptha, in equal proportions, burned in an ordinary petroleum

lamp, the wick being turned so that smoke formed upon the chimney, which was collected, furnished the best material for the purpose. A quantity of lamp-black, exactly as it was taken from the lamp chimney, was exhibited in a bottle by Prof. Barker. The peculiarities of this material, he went on to say, are two-fold. (1.) It is the finest variety of lamp-black which can be artificially produced. (2.) Its great conductivity; it is quite as good a conductor as spongy copper. A certain quantity is weighed out carefully and placed in a steel die, and is subjected to a pressure of 1,200 pounds to the square inch. This constitutes the carbon button. He could not bring a specimen with him owing to its extreme frangibility. It can be used as a portion of an electrical circuit, as an electrical resistance, first, on account of the conductivity of the lamp-black, and, secondly, with the pressure which is exerted upon it. This electrical resistance varies in accord with sonorous vibrations. In practice it is placed in a small case, into which is dropped a little disk faced with platinum. Contact is made at the top and bottom with wire. It may be adjusted to any resistance within the range of its own limit which may be chosen. The limits may be varied also by the pressure employed in making the carbon button. If the pressure is increased, the sensitiveness of the button is very materially increased. The first practical application of the button was, of course, with the telephone. The problem involved in the telephone is, theoretically, a very simple one. There is an instrument at one end called a "transmitter," whose function it is to translate sound waves into electrical waves. At the further end there is an instrument called a "receiver," whose object is to translate electrical waves back again into sound waves. In the magneto-electrical telephone both functions are served by the same instrument. In all of the telephones now in use the same force which sends the current, or which produces the waves in the current, produces the current itself. A portion of the energy of the voice is used in producing the magneto-electrical current and another portion is used for the purposes of articulation. Prof. Maxwell gives it as his opinion that the telephone of the future will not be the magneto-electrical telephone, and for reasons which seem obvious enough. In the first telephone Prof. Bell used a battery, and used the voice to modify the current. However, in his case the battery current was excessively feeble, and did not produce such good results as the magneto-electrical current did. Now, the problem was to modify the current by the carbon button—to translate, by means of the carbon button, sound wave into electrical waves. The elucidation of this problem is an exceedingly simple one. The strength of the current is exactly proportionate to the pressure exerted on the carbon button. It does not matter whether this pressure is produced with the finger or the tongue. If a strong sound wave strikes it, there is a strong current; if a weak wave there is a weak current. There is an electrical current which copies faithfully every detail of the sound waves and sends them over the wire, and successfully translates the sound waves into electrical waves by means of the carbon button. The ordinary or any telephone may be used as a receiver, but Mr. Edison has invented a receiver of his own. An ingenious arrangement was explained, by which accidents

through "crossing" or lightning can be avoided. A "relay" instrument, invented by Mr. Edison, by which a primary current may be translated into a secondary current, was also exhibited. The carbon button can be applied as a barometer to a variety of other purposes.

After recess, Prof. Barker delivered an address on the principle involved in the microphone and the carbon telephone. He contended that the principle of of the two instruments was identically the same, and that Mr. Edison and not Prof. Hughes, of England, had priority of claim of discovery, although he did not imply that the latter was indebted to the former for the idea, but rather that it was a singular instance of contemporary experiments and almost of discovery.

The address was one of the most interesting that has been placed before the Convention, Prof. Barker possessing a peculiar faculty of elucidation.

Prof. Rees, of Washington University, read the following paper on

THE WORK DONE BY THE FORT WORTH SOLAR ECLIPSE PARTY.

This party was composed of Leonard Waldo, of Cambridge Observatory; R. W. Willson, of Harvard University; W. H. Pulsifer, of St. Louis; F. E. Seagrave, of Providence, and the speaker.

Fort Worth had been chosen as the place of observation for several reasons:

1. Weather reports obtained from Colorado and Texas showed the chances for clear weather to be better in Texas.

2. The totality came to Fort Worth fifteen minutes later than it was seen at Las Animas, and, therefore, it seemed probable that we would be able to show in our photographs, and, perhaps, the sketches, any great changes in the corona.

Mr. Wilson left St. Louis July 8 to arrange for the exchange of longitude signals between St. Louis and Fort Worth, and to make the needed arrangements for the party's work.

On the night of July 15 an exchange of longitude signals was made, through the kindness of Col. R. W. Clowry. Mr. Waldo, at this end of the line, made use of a transit instrument set up in the observatory of the Washington University. Mr. Wilson used a Stackpole sextant and subsequently a transit loaned by Brown University, Providence.

The rest of the party, except Mr. Pulsifer, reached Fort Worth on the 18th. Mr. Lomax, cashier of the City National Bank, generously placed his grounds, houses and horses at our disposal. The days before the eclipse were occupied with work on the adjustment of instruments and observations with sextant and transit for latitude and time. Mr. Willson had contrived a very steady sextant stand, which enabled Mr. Waldo to make observations on Polaris and Antares with great accuracy. Observers along the path of totality in Texas were requested to coöperate with our party; descriptive articles were written for the papers, and selections of Prof. Wm. Harkness' valuable instructions were printed and sent to each person desiring to act with us.

We readily established observers at Dallas, near Hearne, McKinney, near the

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limit of shadow, Allen and Cleburne. Some of these observers were furnished with stop-watches. A class of some twenty sketchers was organized, under the direction of Mr. Waldo, and were trained in sketching from pictures of the corona —allowing them 2m. 30s. The practical part of the photographic work was put in the hands of Mr. Alfred Freeman, of Dallas.

The instrumental equipment of the party was as follows: Mr. Waldo had under his care the photographic apparatus, including two cameras arranged with double refracting prisms, loaned by Dr. Litton, after the suggestion of Prof. E. C. Pickering, for photographing any effect produced by polarization. Mr. Waldo also used a small telescope for observing contacts. Mr. Willson used a beautiful three-inch telescope, kindly loaned the party by E. Ellery Anderson, of New York City. Mr. Seagrave had a 5-in. Clark refractor to which he adapted his own spectroscope of 10 prisms by Browning. Mr. Pulsifer joined the party four days before the 29th, bringing with him his Clark 4-inch telescope and two spectroscopes, one of which was fitted to a spare 3-inch telescope belonging to Mr. Seagrave; the other was attached to Mr. Pulsifer's own instrument. I had in hand a 5th Alvan Clark spectroscope, loaned by Mr. Smith, of Boston, to which I had attached a very fine spectroscope (belonging to Waldo), of two prisms, and furnished with long collimator and telescope.

Although the weather for two days before the eclipse promised badly, yet on the afternoon of the 20th the clouds broke only a few minutes before the first contact, and we had a fine view to nearly the last contact.

In regard to the work done during the eclipse, Mr. Waldo reports as follows:

1. He saw the diffraction shadows flitting over the ground at totality.

2. First contact, 3 h. 11 m. 29 sec.; duration of totality, 2 m. 28.7 sec.; fourth contact, 5 h 19 m. 16 sec.

3. The photographs show detail, though moved, because the small prominences are drawn out along the plate.

4. The corona was very different from any of the coronas drawn during preceding eclipses. The parts of it towards the North and South Poles of the heavens seemed pretty well defined, but the two ends which lay roughly in the ecliptic were very poorly defined, and probably extended much farther than the naked eye saw.

There was not visible at a glance any of the wonderful streamers portrayed during former total eclipses as radiating from the sun, but there were visible variations in the light from different parts of the corona, which gave the impression of unequal densities.

Mr. Willson, with the three-inch Secretan, with universal mounting, observed the first contact with terrestial eye piece, magnifying forty diameters, and noted the second contact with an inverting eye-piece of 150 diameters. During the partial phase both these eye-pieces were used. For third contact and during totality a power of about thirty diameters was used, the field of view being about 1° diameter. In this eye-piece was a glass plate ruled with concentric circles (by Rogers, of

the Harvard observatory) about 6 m. apart, whose circumferences were divided into arcs of 45° each by lines radiating from their common center.

Mr. Willson was also provided with an ordinary Arago polariscope, (Dr. Litton's) and with one of Browning's direct vision spectroscopes to be used as occasion should offer. Observations were made of all the contacts. Prof. Willson, in his paper on the subject, says: Just before the totality I replaced the darker shade upon the telescope by a light reddish glass and caught up the chronometer beat, watching for the contact with my left eye, my right being bandaged. Totality having commenced, I removed the bandage from my right eye and examined the corona. My first glance caused me great surprise. The moon's disk appeared surrounded by a reddish glow (with a slight orange tinge), much brighter towards the moon's limb, of uniform texture in all parts of the circumference, but fading gradually to a well-defined surface about four or five minutes from the moon's limb. Neither chromosphere nor prominences were anywhere visible; this was my first, and I must say, disappointing impression. Just as the time-keeper called 2:15, however, I discovered that I had forgotten to remove my glass shade, which I immediately did, regretting that I had lost fifteen seconds of precious time—perhaps not lost, I think now, for my observation of the portion visible through the shade may prove to be of use, and seems to discriminate between the colors of different parts of the corona, for as soon as I removed the shade I became aware of other portions of the corona whose light was very nearly as intense as that near the moon's limb, but which were invisible through the shade, while the ring seen with the shade, was not at any time distinctly seen without it. To my view the light of the corona varied somewhat in the different portions; and its outlines were very irregular, but well defined.

Of the protuberances visible, only one was of good size, extending somewhat more than a minute and a half from the sun and having somewhat of a sickle shape, the others were all small, but of a peculiar appearance. Mr. Seagrave reports that the thermometer fell 11° during totality. The first intimation of the moon's approach was given by Mr. Seagrave, who, intently observing with his spectroscope, called out, "Chromosphere gone!" Willson noted the contact six seconds later. Mr. Seagrave says he saw a continuous spectrum with one bright line 1,474, which was measured at the base. At the critical moment Mr. Pulsifer's assistant, completely overcome by excitement, was unable to lend him any help. An untrained man stepping in at this juncture did what he could. Mr. Pulsifer intended to use both of his spectroscopes with his own four-inch telescope, but experiment showed that too much time would be lost in changing. The single prism spectroscope was adapted to the spare three-inch Clark telescope, which had a very shaky mounting and stand. The direct vision spectroscope was fitted to the fourth Clark telescope. For the reason above named Mr. Pulsifer lost the spectroscopic contact. Removing his prism spectroscope and adjusting his solar diagonal eye-piece he observed the sun in partial eclipse; saw few faculæ; serrated edge of moon's limb very sharply defined; cusps clean cut; no brushes of light at cusps; granulations and faculæ extended close to moon's

limb. The direct vision spectroscope was fitted to telescope sometime before totality. New prominence lines were looked for, but none found. About three seconds before totality the slit was placed tangential to that part of the sun's image where the second contact would occur, narrowed and focused till the spectrum came out beautifully clear. The field covered the *c* line. At last there came an instant when it seemed that the spectrum entirely vanished, then a flash, and the lines blazed out bright, the whole phenomena occupying so short a time that no estimation of its length could be formed. Mr. Pulsifer describes the phenomenon as follows: I was startled to find the lines shortened at each end, and occupying not more than one-third or perhaps one-fourth of the width of the spectrum. I had never seen anything of the kind before, but was instantly reminded of Miller's maps of the ultra violet spectrum of platinum, but the lines were sharp, not nebulous, except that the ends seemed rounded off. It seemed to me that the *c* line did not shorten, or at least to such a degree as the other lines, and that it remained in sight for an instant after the other lines had disappeared. * * * In regard to whether prominences and corona are visible before totality, he says: I can furnish some information on this point. I observed the eclipse of 1869 from my observatory in St. Louis some twenty-five or thirty miles southwest of the line of totality. At that time I observed several prominences on the limb of the sun just at the points where the limb of the moon exactly (or nearly so) covered the sun's limb. I made a drawing at the time, but it has been mislaid or destroyed.

My own observations, Prof. Rees went on to say, during the partial phases showed the moon's limb very irregular, and, toward the center, affected by a slight undulation. This undulation was not communicated to the cusps, which were very sharply cut. In the extreme points, both before and after totality, dots of light were observed, of the same color as the faculæ. During totality the spectrum of the corona, pointing the telescope to four points of the corona was always continuous, and the Fraunhofer lines *c* and *d* were plainly visible.

The light of the "wings" of the corona was varied, giving, to my eye, the appearance of parallel rays, and not radials. These wings were in the line of the ecliptic, and the rays were also parallel to the ecliptic.

The darkness during totality was not so great as I expected. I was well able to read fine divisions on my slit screw-head without any extraneous light.

Col. Lockett, of Tennessee, made the best sketch the party had, and a copy in oil of his sketch was exhibited by Prof. Rees. Prof. Barker showed the *Graphic* copy of Draper's photography of the corona, and compared it with the telescopic view by Mr. Willson.

Discussion on the paper was deferred until morning.

The chemical sub-section listened to the reading of a most valuable and interesting paper by Dr. J. Lawrence Smith, of Louisville, on the discovery by him of the oxide of a new element, for which he proposes the name of Mosandrum, a metal allied to the cerium group. This is the only element ever discovered by

an American, and is remarkable as not having been detected, as most of the latter elements were, by means of the spectroscope.

The next paper read before this section was by Prof. Riley and treated of "The means by which silk worm moths issue from their cocoons."

One of the most interesting articles in the room of this section was a photograph of a new fossil impression in a glacial boulder of metamorphic sandstone, found near Buffalo, N. Y., and exhibited by Mr. A. R. Grote. The impression is remarkable as being the only fossil mark ever found in a glacial boulder, and it is probably referable to some species of Protozoan allied to *Oldhamia*.

Two other papers were read by substitution; "On a Remnant of the Spectacles in *Amia* and *Lepidosteus*," by Burt. G. Wilder. "The Development of *Amia*," by S. A Forbes.

SECTION B

listened to the reading of the following papers:

Embryology of Clepsine (1) Stages preliminary to Cleavage (2) Cleavage, Germ lamellæ, Gastrula, etc., C. O. Whitman.

Extracts from Modern Science bearing on the Law of Repetition, Miss V. K. Bowers.

Richthofen's Theory of the Loss in the Light of the Deposits of the Missouri, James E. Todd.

Are the so-called Chætetes of the Cincinnati group Bryozoans? (read by title,) A. G. Wetherby.

Remarks on the Geographical Distribution of the land and fresh water Mollusks of the United States, and their local varieties.

Remarks upon the Archæology of Vermont, G. H. Perkins.

The Relation of Adhesion to Horizontal Pressure in Mountain Dynamics (read by title), H. F. Walling.

Some Indications of Recent Sensitiveness to Pressure in the Earth's Crust (read by title), H. F. Walling.

Remarkable Burial Custom from a Mound in Florida—the cranium utilized as a cinerary urn, Henry Gilman.

Description of a Glazed Earthen Vessel, taken from a tumulus in Florida, Henry Gilman.

Evidences of Cannibalism in a Nation before the Ainos in Japan, E. S. Morse.

The last three papers were read for their authors by the Secretary.

Just before close of the session, Capt. C. E. Dutton commenced the reading of his paper on the "Geological History of the Colorado River and Plateaus."

In the evening, at Mercantile Library Hall, Mr. Wm. J. Marshall delivered his lecture on the Yellowstone National Park, of which it is eminently safe to say that, in point of simple interest and magnificence of illustration, it surpassed any lecture ever given in St. Louis. There was a full house and a very critical audience; but, fastidious as they were, it was only necessary for them to see the

views to burst out into applause. Mr. Marshall showed them a map of the National Park and told his audience how they could get there. Then, in very rapid succession, he displayed pictures of the famous Sentinel Rock, the Madison Falls, the Lower and Upper Geyser Basins, with views of the "Old Faithful" Geyser, Bee Hive Geyser, Pluto's Well, Specimen Spring, the Castle Geyser—a view more splendid, in point of fairy-like texture and brilliancy than any transformation scene that the stage ever saw—the Grand Geyser, some petrified grasshoppers, mud volcanos, the Yellowstone Lake, (view by moonlight,) the Upper and Lower Falls of the Yellowstone, Grand Cañon by moonlight, Tower Falls, the East and North Fork Falls on Gardiner River, some more lakes, a magnificent view of foliated calcareous incrustations in a spring on the Gallatin River, and wound up by showing the "Liberty Cap," surmounted by the Stars and Stripes. The text of the lecture given in a singularly fascinating way, was full of quiet humor and often eloquent. At the conclusion of the unequaled show, the lecturer was rewarded by unbounded applause.

Tuesday witnessed the closing exercises of the Association.

In Section A., Prof. Nipher, of Washington University, read the following paper on

RAIN MEASUREMENTS ON THE ROOFS OF BUILDINGS.

Somewhat over a century ago, the theory gained currency that a considerable portion of the rain which falls upon the surface of the earth was condensed from the lower strata of the atmosphere, within 100 or 200 feet of the ground, and did not fall from the clouds as one might naturally suppose. This idea grew out of the observed fact that rain-gauges placed at different elevations above the ground showed a less rainfall as the gauges were placed at higher elevations.

Howard, Dr. Frail and others, suggested that this apparent decrease in rainfall for higher elevations was caused by wind; and, in 1861, Prof. Jevons proved that condensation in the lower strata, is, in all possible cases, inappreciable, and pointed out with clearness the action of the wind in robbing the elevated gauges of their rain. His explanation is, briefly, that any obstacle placed in a stream of air causes the air to sweep over the top and around the sides of the obstacle with an increased velocity. As a result the drops which but for this disturbance in the air current would fall into the gauge are deflected from their paths, and no longer fall parallel to the general direction of the paths in the undisturbed stream. The drops evidently drift to the leeward. This explanation gives the key to the solution of the experimental results of Symmonds, who found that cylindrical gauges gave the most uniform results, and that gauges of a less diameter than two and three-quarter inches gave too small a result when placed at the elevation of one foot.

The conclusions which Jevons draws are that observations by rain gauges elevated and exposed to the wind must be rejected as worse than useless.

Nine years later (1870), the Rain Committee of the British Association made

a report at the Liverpool meeting. The results of their experiments confirmed the explanation of Jevons. It was found that the maximum of rainfall was obtained when the mouth of the gauge was placed at the surface of the ground, in summer, and 2½ to 3 inches below the surface in winter. These gauges were placed in a pit in order to prevent splashing. It was also found that the variation of the indications of the gauge was most rapid near the ground and the loss was greatest during the winter months. Unfortunately, the Committee has not been sufficiently explicit in stating to what extent the gauge was exposed to the wind, or whether it was shielded by houses in the vicinity.

In his paper in 1861 (Phil. Mag.), Jevons suggested a form of gauge that he believed to be the "most unexceptionable," as follows: "The most unexceptionable rain gauge would consist of a sheet of metal many feet square (for instance ten feet), spread flat upon the ground in an open place, with a flat collecting vessel in the center, connected by a pipe with a sunken reservoir or recording apparatus. The edges of the vessel should not be higher than an inch, so as to present no appreciable obstacle or hollow space to the wind. At the same time nothing could be lost by splashing, for the splashes within and without the vessel would be equal."

It is to be remarked here that at many important observatories it is impossible to get a ground exposure of any kind, and in such cases this form of gauge would be of little service. A more vital objection is that is not probable that the splashing into and out of the collecting vessel will be equal. In general, and particularly for violent rains, an accumulation of water in the collecting vessel would bring about a very different result.

It probably occured simultaneously to my colleague, Prof. Woodward, and myself, that this difficulty would be completely met by covering Prof. Jevons' metal sheet with square cells of equal size, each drained by equal openings at the bottom, those near the center alone being used as collectors, the others being used only to secure uniformity of splashing. This gauge seems to me to be practically perfect.

Such a gauge can not be used very generally for rain measurements, but for purposes of comparison with the more generally used, and certainly less accurate forms, it is of great value. Thus far we have been unable to find a proper exposure in St. Louis. It is hoped that this will be accomplished during the coming year.

In the meantime it is hoped that some more favorably situated person will also make a similar comparison.

After some consideration it occurred to me that by shielding the gauge from the wind by means of some device which would deflect the wind downwards, instead of allowing it to sweep up over the mouth of the gauge, the conditions of the "pit gauge" of the British Association Committee might be realized. After many unsuccessful attempts, the shield which you see before you was hit upon, which has proved perfectly successful.

The gauge is a cylinder 7.08 centimeters in diameter and about eighteen

inches long. Six inches from what is to be the lower end of the gauge, a false bottom is made, and the cylinder is set over a turned post set into the ground. Around this gauge is placed a trumpet-shaped shield, with the mouth, or flaring part up. The shield is furnished with a clamp-screw at the bottom, and is braced near the top by metal strips reaching from the shield to a sliding collar which encircles the gauge. By this means the shield can be set at any desired altitude.

Two gauges were set at an altitude of six feet above the ground, the one shielded, the elevation of the shield being zero above the top of the gauge. The other gauge is unshielded. According to the investigations of the B. A. Committee, gauges of this elevation should indicate a rainfall 92 per cent. of that given by the "pit gauge." The unshielded gauge has, during the last summer, shown a rainfall of 97 per cent. of that given by the shield gauge. This excess by the shield gauge is plainly showed at every rain. The fact that the difference between the gauges is less than that found by the B. A. Committee, using the "pit-gauge" is easily explained. Both of our gauges are partly protected from the wind by adjacent houses and lattice-work fences. In fact, they are so well shielded that I had expected to find little, if any, difference between the two. I shall take pleasure in showing them to any member who may take interest in the matter.

The English meteorologists lay much stress upon the elevation of rain gauges, maintaining that gauges are not really comparable unless they have equal elevation above ground. It seems clear to myself, at least, their exposure to wind is an equally important factor, and I feel sure that the so-called correction due to elevation, may be reduced to zero, by properly shielding the gauge from the winds, and that the gauges may then have any desirable or convenient location.

This conclusion has been severely tested during the past summer, by gauges placed upon and above the roof of the Central Tower of the University building.

The experiment soon convinced me that no gauge placed directly on the roof could give the true rainfall, except by accident, or under very special circumstances. These circumstances are, that the roof shall be square and flat, or nearly so, and of large size, the gauge being placed in the center of the roof. These conditions have fortunately been realized in the gauge of Dr. Geo. Engelmann, of this city. A balustrade also surrounds his gauge, which is also an important advantage. Being unable to secure such an exposure on the roof of the University building, the gauge was finally raised to an elevation of eighteen feet above the roof, and one hundred and eighteen feet above the ground. It was found that the unshielded gauge, compared with the ground gauge, showed a loss of 18 to 20 per cent.

The shield was placed around the gauge, and clamped with its rim at various elevations above the top of the gauge. It appears that at an elevation of three and a half inches the shielded gauges on the ground and on the roof will bear like relations to the unshielded ground gauge. When placed at this elevation the wind appears to have little effect upon the amount of water caught. Even when at other elevations the true ground rainfall has been shown during calms, as can

be seen in the table above, and as was also found in the guages placed upon the roof. The results appear, then, to show that the results obtained by the "pit gauge" of the B. A. committee can be realized by a properly shielded gauge placed at any convenient elevation, and which, therefore, meets the serious objections urged against the general use of the "pit gauge."

The following papers were also read:

On the Possibility of observing the Solar Corona without the aid of an eclipse, Ormond Stone; On a modified form of Telephone intended for a Sensitive Electroscope for the Detection of Feeble Currents, P. H. Vander Weyde; A Peculiar Case of Fracture of Tool Steel, Wm. Kent; Internal Revenue Adjustment of the Carlisle Tables, E. B. Elliott; International Coinage—its progress, E. B. Elliott; The Rainfall of the Arid Region of the United States, J. W. Powell.

A paper was read by Mr. E B. Elliott, of Washington, D. C., entitled,

THE INTERNAL REVENUE ADJUSTMENT OF THE CARLISLE TABLES.

The Internal Revenue Bureau, many years ago, adopted as the basis of its computations in the assessment of taxes on legacies, distributive shares and successions, the "Carlisle Tables," and 6 per cent as the rate of interest.

These tables represented very fairly the class of lives interested in legacies in succession, but were in certain respects faulty. The data from which they were computed were comparatively small, the entire number of deaths being less than 2,000. Owing to this paucity of data, irregularities necessarily resulted, and the mortality at certain older ages was represented as being less than at the younger ages immediately preceding. This was notably the case at certain very advanced years of life. For instance, the present value of a dollar due at death was made for each of the six years of age, from age ninety-two to age ninety-seven, inclusive, to be smaller than for either of the ages immediately preceding, the average of value for these six years being .80,523, while the value for the age ninety was .81,513, and for the age ninety-one, .81.615; that is to say, while the present value of a revisionary payment of one hundred dollars due at death of a person aged ninety and ninety-one is about $81.50, the value of such reversion for the following six years averaged $80.50. These extreme irregularities had not produced very great inconvenience in practice, they being found chiefly at the more advanced ages, where there were but few actual transactions. In the publication, however, of the new instructions to Internal Revenue Assessors, as to the levying of taxes on life and revisionary interests in heritable property, it was deemed advisable by the office to secure such an adjustment of these valuable tables as, without widely departing from the general character of the results, would remove these irregularities. Mr. Elliott was accordingly requested to prepare such adjustment, and the tables so adjusted were presented to the Associa-

tion, with an explanation of the mathematical process by which the results were obtained. In the tables furnished future duration, or "expectation of life," so called, was not given, it being of no practical use in the assessment of taxes. A column entitled "redemption period" is given, it denoting a period of years in which the present values of annuities and reversions certain will become equivalent, respectively, if computed at an interest of 6 per cent per annum, to the present values of annuities and reversions contingent on the duration of life. Mr. Elliott expressed regret that we had no national system for the registry of deaths, although in certain states such systems were established, and he moreover expressed the hope that Congress would take early steps to bring about such a coöperation between the National Government and the governments of the several states as would result in an efficient and uniform system for the registry of births and deaths.

Mr. Elliott then read a paper on "International Coinage—Its Progress." He stated the condition of the monetary question in the United States and abroad a year ago as presented at the Nashville meeting of the Association, and mentioned the changes which had taken place since then. He also gave a full explanation of the difficulty which seems of late to have arisen in relation to the trade dollar.

BIOLOGICAL NOTES ON THE GALL-MAKING PEMPHIGINÆ.

BY PROF. CHARLES V. RILEY.

(*Abstract.*)

The life-history and aganic multiplication of the plant-lice (*Aphididæ*) have always excited the interest of entomologists and even of anatomists and embryologists. The life-history, however, of the gall-making species belonging to the *Pemphiginæ* has baffled the skill of observers more than that of any other group.

Prof. Riley is about to publish some new biological discoveries relating to this family of insects, in connection with a descriptive and monographic paper by Mr J. Monell, of the St. Louis Botanic Gardens. The paper laid before the Association simply records some of the yet unpublished facts discovered.

All of the older writers in treating of the different gall-producing *Pemphiginæ* of Europe have invariably failed to trace the life-history of the different species after the winged females leave the galls, and, with few exceptions, have erroneously inferred that the direct issue from the winged females hibernates somewhere. The most recent production on the subject is a paper published the present year in Cassel, Germany, by Dr. H. F. Kessler, entitled the "Life-History of the Gall-Making Plant-Lice, affecting *Ulmus Campestris.*" The author, by a series of ingenious experiments, rightly came to the conclusion that the insects hibernate on the trunk, but he failed to discover in what condition they so hibernate.

Led by his previous investigations into the habits of the Grape *Phylloxera*, Prof. Riley discovered, in 1875, that some of our elm-feeding species of *Pem-*

phiginæ produce wingless and mouthless males and females, and that the female lays but one solitary impregnated egg. Continuing his observations, especially during the present summer, he has been able to trace the life-history of those species producing galls on our own elms, and to show that they all agree in this respect, and that the impregnated egg produced by the female is consigned to the sheltered portions of the trunk of the tree and there hibernates—the issue therefrom being the stem-mother which founds the gall-inhabiting colony the ensuing spring.

Thus the analogy in the life-history of the *Pemphiginæ* and the *Phylloxerinæ* is established, and the question as to what becomes of the winged insects after they leave the galls is no longer an open one. They instinctively seek the bark of the tree and there give birth to the sexual individuals, either directly, or in one species through intervening generations.

The section then adjourned.

SECTION B.

The following papers were read in Section B: On the Consensus in animal and vegetable life, Lester F. Ward; Notice of a recent discovery of gold in the Unaka Mountains of Tennessee, James H. Safford; Notice of certain sulphide springs in Tennessee, James M. Safford; An atlas of North American antiquities, O. T. Mason; North American Indian synonymy, O. T. Mason; On *Ægeria tipuliformis* Lin. Geo. H. Perkins; Osteology of *Sciuroptreus volucella*, Geo. H. Perkins.

We have now given as full a report of the proceedings as our space will permit, and close it by giving a list of the newly elected officers and of the total number of papers filed with the Secretary.

Many other papers were read before the sections and sub-sections which we should be glad to publish, but cannot for the reason given above, and for the additional reason in some cases that we have not been furnished with copies or abstracts of them.

We will conclude Prof. Newcomb's most admirable and comprehensive address in our next issue; also several other interesting papers that have been furnished by their authors.

The number of old members present was one hundred and thirty-three, and of new ones elected, two hundred and sixteen; fellows elected, sixteen.

The people of St. Louis were particularly attentive to the members, and endeavored to make their visit pleasant and interesting, by a banquet at the Lindell Hotel, concerts, excursions to Iron Mountains under the leadership of Prof. Broadhead, the Cahokia Mounds, the Waterworks, Shaw's Garden, the Silver Reduction Works at Cheltenham, the Artificial Ice Factory, &c., besides which the Mercantile Library, Prof. Shumard's magnificent collection of minerals and fossils and various other collections of interest, were freely thrown open to them, all of which courtesies were duly acknowledged officially.

On Tuesday evening at 8 o'clock the Association adjourned to meet at Saratoga, N. Y., the last Wednesday in August.

OFFICERS ELECTED FOR 1879.

President, Geo. F. Barker, of Philadelphia, ; Vice-President Section A, Prof. S. P. Langley, of Alleghany; Vice-President Section B, Maj. J. W. Powell, of Washington; Chairman of Subsection of Chemistry, Prof. Ira Remsen, of Baltimore; Chairman of Subsection of Microscopy, Prof. Edw. W. Morley, of Hudson, O.; Permanent Secretary, F. W. Putnam, of Cambridge; General Secretary, Dr. Geo. Little, of Atlanta; Secretary of Section A, Prof. John K. Rees, of St. Louis; Secretary of Sec ion B, Prof. A. G. Wetherby, of Cincinnati; Treasurer, Wm. S. Vaux, of Philadelphia; Auditing Committee, Dr. Henry Wheatland, of Salem; Thomas Meehan, of Philadelphia.

TITLES OF PAPERS FILED FOR THE ST. LOUIS MEETING.

On the Sources of Aboriginal History of Spanish America, Ad. F. Bandalier.

Experimental Determination of the Velocity of Light, Albert A. Michelson.

The Gold Gravel of North Carolina, its age and mode of formation, and the history of its discovery and working, W. C. Kerr.

Dominant Forms of Topography of North Carolina in Mountain and Plain and their geological explanation, W. C. Kerr.

Sand Dunes on the Coast of North Carolina and their geological and topographical significance, W. C. Kerr.

Ancient Mounds in the Vicinity of Naples, Scott county, Illinois, J. G. Henderson.

Tornadoes, Waterspouts and Hailstorms, Wm. Ferrel.

The Natural Features of the Yellow Stone National Park, Wm. I. Marshall.

Ancient Glacial Action, Kelly's Island, Lake Erie, Chas. Whittlesey.

The Philosophy of the Movements of the Rocky Mountain Locust (*Calopteus spretus*), Chas. V. Riley.

A New Source of Wealth to the United States, Chas. V. Riley.

Notes on the life-history of the Blister-beetles, and on the structure and development of the genus *Hornia* Riley, Chas. V. Riley.

On the larval growth of *Corydalus Chauliodes*, Chas. V. Riley.

On the Means by which Silkworm moths issue from their cocoons, Chas V. Riley.

On Hybrids in Nature, Thos. Meehan.

Remarks on the Early Decay of the male plant in *Cannabis sativa*: A Parallel and a Contrast, C. S. Percival.

A Wind-vane thoroughly Sensitive and thoroughly Steady, Wm. Curtis Taylor.

An improved Method of Ringing a Bell in an Exhausted Receiver, Thos. R. Baker.

Immortality, W. H. H. Russell.

The Science of Government, W. H. H. Russell.

The Iron Ores of Alabama, with Special Reference to their Geological Relations, Eugene A. Smith.

Ancient Names, Geographical, Tribal and Personal, in the Mississippi Valley, J. G. Henderson.

The Electrolytic Estimation of Mercury, F. W. Clarke.

Embryology of Clepsine (1) Stages preliminary to Cleavage (2) Cleavage, Germ-lamellæ, Gastrula, etc., C. O. Whitman.

Description of Two Stone Cists discovered near Highland, Ill., Arthur Oehler.

Description of a Cliff House in the Cañon ot Mancos River, Colorado, with a Ground Plan of the structure. Wm. F. Morgan.

Remarks on the Ruins of a Stone Pueblo on the Animas River, New Mexico, with a Ground Plan, Lewis H. Morgan.

Observations on the San Juan River District, as an important ancient seat of Village Indian Life, Lewis H. Morgan.

Magnetic Determinations in Missouri, Francis E. Nipher.

On the Determination of Rainfall on Roofs, Francis E. Nipher.

On the use of the Tasimeter for measuring the Heat of the Stars and of the Sun's Corona, Thos. A. Edison.

On Finding the Differential of a Variable Quantity without the use of Infinitesimals or "Limits," Joseph Ficklin.

On the complete series of Superficial Formations in Northwestern Iowa, with Sections, W. J. McGee.

The Law of Repetition, Miss V. K. Bowers.

The Science of Human Nature, a Philosophical View of the Law of Habit or Repetition, Miss V. K. Bowers.

The Universally Implanted, or Race Faculties and Personal Character, Miss V. K. Bowers.

Extracts from Modern Science bearing on the law of Repetition, Miss V. K. Bowers.

Richthofen's Theory of the Loess in the Light of the Deposits of the Missouri, James E. Todd.

On the Economic use of Steam, Chas. A. Smith.

Notes on Antimony Tannate, Ellen S. Richards and Alice W. Palmer.

Outline of Work done by the Fort Worth Solar Eclipse Party, J. K. Rees.

Are the so-called Chætetes of the Cincinnati Group Bryozoans? A. G. Wetherby.

Remarks on the Geographical Distribution of the Land and Fresh-water Mollusks of the United States and their local varieties, A. G. Wetherby.

A new Fossil impression in a Glacial Boulder, A. R. Grote.

Remarks upon the Archæology of Vermont, G. H. Perkins.

On Friction Measurements and its Laws, as determined by Recent Experi-

ments for a wider range of Conditions than have been previously obtained, R. H. Thurston.

Dinosaurian Reptiles from the Jurassic of the Rocky Mountains, O. C. Marsh.

Ancient Pottery from Chiriqui, Central America, O. C. Marsh.

The Relation of Adhesion to Horizontal Pressure in Mountain Dynamics, H. F. Walling.

Some indications of Recent Sensitiveness to Pressure in the Earth's Crust, H. F. Walling.

Remarkable Burial Custom from a Mound in Florida. The Cranium utilized as a Cinerary Urn, Henry Gillman.

Description of a Glazed Earthen Vessel, taken from a Tumulus in Florida, Henry Gillman.

Evidences of Cannibalism in a Nation before the Ainos in Japan, E. S. Morse.

Geological History of the Colorado River and Plateaus, C. E. Dutton.

A Peculiar Case of Fracture of Tool Steel, William Kent.

On the Consensus in Animal and Vegetable Life, Lester F. Ward.

Some new Selenocyanates, F. W. Clarke.

Some Specific Gravity determinations and conclusions from them, F. W. Clarke.

Notice of a recent discovery of Gold in the Unaka Mountains of Tennessee, Jas. M. Safford.

Notice of Certain Sulphide Springs in Tennessee, Jas. M. Safford,

The Importance of Meteorological Observations in Vertical Sections of the Atmosphere, with the suggestion of means for their systematic accomplishment, J. W. Osborne.

On the Construction of a Sensitive Wind-vane, J. W. Osborne.

On Wind-vane Rotation, J. W. Osborne.

On the development of Ozone in the air by means of sudden changes of temperature, Benj. S. Hedrick.

An Atlas of North American Antiquities, O. T. Mason.

North American Indian Synonomy, O. T. Mason.

The Lands of Utah, J. W. Powell.

The Rainfall of the Arid Region of the United States, J. W. Powell.

On a remnant of the Spiracles in *Amia* and *Lepidosteus*, Burt G. Wilder.

On *Ægina tipuliformis* Lin., George A. Perkins.

Osteology of *Sciuropterus volucilla*, George A. Perkins.

On the Development of *Amia*, S. A. Forbes.

On the Influence of the Drainage rate on Climate, Chas. W. Johnson.

The Matter of Life, Chas. W. Johnson.

On some Characteristics of the Vegetation of Iowa, J. C. Arthur.

On the Possibility of Observing the Solar Corona without the Aid of an Eclipse, Ormond Stone.

On the Application of the Carbon Button, T. A. Edison.

On the Principle involved in the Microphone and the Carbon Telephone, T. A. Edison.

A new Voltameter, T. A. Edison.

On the Results of the Spectroscopic Observation of the Solar Eclipse of July 29, 1878, G. F. Barker.

A new Method of Determining the Pitch of a Tuning Fork, G. A. Barker.

On certain Difficulties met with in Using the Cat's Brain as a Type of the Brains of Mammals, Burt G. Wilder.

On the Anatomical peculiarities by which Mound Builders' Crania may be distinguished from those of the Modern Indian, M. J. Mc Gee.

Electricity an Agent in Vegetable Growth, A. P. S. Stuart.

On a modified form of Telephone, intended for a sensitive Electroscope for the Detection of Feeble Currents, P. H. Van der Weyde.

Exhibition of Fossils, showing the Effects of the Geodizing Process, A. H. Worthen.

A Short Account of the Nature of Oxide of the New Element Mosandrum, J. Lawrence Smith.

The new Meteoric Mineral, Daubreelite, and its frequent Occurrence in Nature in Meteoric Iron, J. Lawrence Smith.

On recent progress in Microscopy, R. H. Ward.

On a Standard Inch and a Standard Centimetre, Wm. A. Rogers.

The Aerion; its theories, illustrations and references, Ira H. Stone.

Exhibition of Prehistoric Relics from Missouri, A. J. Conant.

An account of an exploration of a Walled Town of the Moundbuilders of the Cumberland Valley, F. W. Putnam.

On Improvements in Electric Clock Systems, F. E. Nipher.

On the Compass Plants, George Engelman.

On the Discovery of a Human Skull in the Drift, near Denver, Colorado, Thomas Belt.

Discovery of Atlantosaurus and other Dinosaurs in the Rocky Mountains of Colorado, A. Lakes.

International Coinage, E. B. Elliott.

Internal Revenue Adjustment of the Carlisle Tables, E. B. Elliott.

Biological Notes on the Gall-making Pemphiginæ, C. V. Riley.

The Alleged Volcano at Bald Mt., North Carolina, F. W. Clarke.

On an error in estimating the strength of a steam boiler, Samuel Marsden.

The Gold Regions of Georgia, George Little.

PREHISTORIC RUINS.

Back of the lost Aztec cities there are in this region of country not merely traces but very well-preserved ruins of the dwellings of a people who lived so long ago that not history or tradition, or even a legend, has kept even so much

as the shadow of their memory. Prof. Tucker, of Hayden's United States Survey, has made quite a study of their remains, and has given some interesting details concerning their discovery.

At first the distance of these cave dwellings was unknown to the party, but one of them, sharper-eyed than the others, suddenly descried way up near the top of the bluff, fully a thousand feet from their base, perfect little houses sandwiched in among the crevices of the horizontal strata of the rock of which the bluffs were composed.

At the peril of his life one of the party scaled the precipice, and letting himself down into one of the houses, found the masonry as firm and solid as when first constructed, and so smooth and even that the casual observer from the cañon below would not notice the difference between it and the rock itself once in fifty times passing.

The Cliff House in the Mancos was one of the wonders of their discoveries, it being first seen one evening just as the sun was sinking behind the western walls of the cañon. Perched in its little nook, like a swallow's nest, the Cliff House was found to be two stories in height, and evidently an edifice of considerable distinction, as its upper windows command an extended view down the cañon, and its position generally that of pre-eminence over the entire section thereabouts. The interior was found to be arranged far more elaborately than in any other building yet explored, the windows incased in wood, neatly fashioned, the sills and lintels still showing evidences of having been stained in imitation of dark woods, and most of it in a remarkably fair state of preservation. Some distance from the building, and upon other ledges, the ruins of quite a number of smaller buildings were found, and all of them ranging from seven hundred to one thousand feet from the bottom of the cañon below. Many readers will recall the models of these cliff houses, which were on view at the Centennial Exhibition, in the Government department, and which were always the center of a fascinated throng of the most intelligent and cultivated visitors.

BOOK NOTICES.

Through the Dark Continent, by Henry M. Stanley. Two volumes in one: pp. 985, octavo, with maps and illustrations. Toronto, John B. Magurn, 1878. For sale by M. H. Dickinson, successor to Matt. Foster & Co. Price, cloth, \$5.50; leather, library style, \$6.50.

This is a Canadian book, printed from *fac simile* plates with the English and American editions and sold at about half the price. It is hardly necessary to say anything further about it, as every intelligent reader in this portion of the West knows all about "Stanley Africanus," and will be in haste to procure an early copy of this his most important work. We will, however, say that this volume is printed and bound in a handsome style, and the illustrations, numbering one hundred and forty-nine, and the ten maps, are executed in the best and most artistic manner, so that it will prove a source of pleasure to the reader, aside from the interest attaching to the subject matter, which, of course, is intensely fascinating. No book of the present day has been so impatiently waited for, and none is more likely to gratify the expectations of those so waiting.

M. H. Dickinson is the sole agent for this region and will send it to any address upon receipt of price.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. OCTOBER, 1878. NO. 7.

PROCEEDINGS OF SOCIETIES.

KANSAS ACADEMY OF SCIENCE.

FURNISHED BY PROF. E. A. POPENOE, SECRETARY.

The eleventh annual meeting of the Kansas Academy of Science was held in Topeka, October 8th and 9th. The evening of the 8th was occupied by Prof. Mudge, of Manhattan, in a lecture upon "The Rocky Mountains and their Fossils," in which the Professor gave the geological explanation of the various configurations noticed in a general survey of the geology of that interesting region. He minutely described the South Park and the Florissant Basin from a geological point of view, remarking upon the semi-tropical character of the insect and plant life of the latter, as evidenced in the splendid fossils of the shale beds. The lecture was delivered in the usual pleasant and attractive manner of the speaker, who can always have an appreciative audience in the West.

At the day session on the 9th, the following persons were made members of the society: Hon. D. B. Long, of Ellsworth; Prof. George Stearns, of Washburn College; Mr. Parker of Robinson, Kansas; Mrs. N. C. McFarland, of Topeka; Mrs. Campbell and Miss A. E. Mozley, of Wyandott, and Hon. D. M. Valentine of Topeka.

The Secretary's report for the past year noted the receipt of a large number of the publications of other societies for the library of the Academy, and also the

donations to the museum. The programme was taken up and papers read in the order given below.

Prof. B. F. Mudge spoke on the connection between the Fossil Forests of the Dakota Group of Kansas with the Fossil Forests of Greenland, showing the great similarity between now extinct forest trees of Greenland and some of those in the fossil beds of Western Kansas, and also certain species now living in the Southern United States.

A paper on certain Kansas minerals was then read by Prof. G. E. Patrick, in which he stated that he had carefully assayed several of the supposed silver-bearing rocks from Wilson county, but failed to find a single trace of the precious metal. He also stated that true magnesian limestone is not found in large quantities in this State, much of the so-called magnesian limestone containing less than one-half of one per cent. of magnesia. In speaking of the crystallized gypsum in Western Kansas, Prof. Patrick stated that the two different forms of the crystallized gypsum occur in separate localities. These two forms are the true crystal and the foliated or leaf-like crystal. The former occurs abundantly in the Saline River Valley, near Russell and in a few other localities. The gypsum crystals and veins occur in ledges of blue shale and are supposed by Prof. Patrick to originate on the evaporation of water holding in solution magnesium sulphate, which abounds in Western Kansas, and bi-carbonate of lime derived from the limestone everywhere present, when it passes through the shale near the face of the ledge in which they are found. This theory is supported by the fact that many veins of gypsum disappear at a distance of about two feet from the exposed face of the shale.

In the course of the discussion on Prof. Patrick's paper, Prof. Mudge remarked that there was no proof of the occurrence of metamorphic rocks in Kansas, and consequently, statements of discoveries of the precious metals in the State were to be discredited, as the metamorphic rocks are the mineral-bearing rocks.

A report on the year's additions to the list of Kansas Coleoptera was then read by E. A. Popenoe, in which about three hundred hitherto undetected species were named. Some question having arisen as to the practical value of a list of beetles to the State, Prof. Snow mentioned a statement noticed in an eastern paper, that since Kansas could show so large a list of beetles it was probably a good State to live in rather than the contrary; reasoning that where so many insects could be found, the plant life must be correspondingly abundant and varied, and consequently the soils for the proper nourishment of plants, native and cultivated, correspondingly rich.

It was adduced that the formerly noxious Colorado potato beetle is now beneficial rather than injurious, having left the potato for a wild species of *Solanum*, the bull-nettle or Santa Fé bur, which noxious weed is undoubtedly checked in its spread by the beetle. A list of additions to the list of Kansas plants was read by Prof. J. H. Carruth, which increased the number to about eleven hundred and fifty, and still further additions may be looked for.

In a paper on the Dermal Covering of the Saurians of Western Kansas, Prof. Snow described fragments of the fossilized skin of this reptile dlscovered by him

in Gove county during the past summer. The fragments discovered show a scaly skin like that of a snake, the scales being a very little smaller than those of a prairie rattlesnake. The fossils are so perfect that the minutest structure of the scales is perfectly preserved, and the skeleton, with which the skin fragments were found, denotes an animal of about twenty-five feet in length.

The paper following related the experiences of a member of the Academy, who was bitten by a rattlesnake. The treatment adopted was that of extracting as much as possible of the venom by suction, and applying a ligature above the wound, by which the poison was prevented from entering the system.

Prof. G. E Patrick gave the result of his examination on the so-called "alkali" of Western Kansas. Prof. Aughey, of Nebraska, has found true alkalies in the soil of that State, but the observations of the speaker have resulted in no such discovery in reterence to Western Kansas. The white efflorescence on the soil, after evaporation, was determined to be Epsom Salts, or magnesium sulphate, 99 per cent., and sodium sulphate, 1 per cent. The taste of the "alkali" water is that of the magnesium sulphate. No effervescence is shown when treated with acid, as would be the case were the efflorescence a true alkaline carbonate.

Judge F. G. Adams read an interesting notice of the existence of Indian mounds in Kansas. These remains of the work of the Mound Builders were first discovered by Mr. McCoy, many years ago, while missionary to the Shawnee Indians, who then occupied Eastern Kansas. Some of the mounds were rediscovered, and a few of them excavated by Judge Adams and Mr. R. J. Brown of Leavenworth, resulting in finding some remains of the extinct race of Mound Builders. The bones were so nearly decayed that they could be, with difficulty, prererved.

In his addition to the list of Kansas birds, Prof. Snow named five species as newly found to inhabit the State. These are Sprague's Lark and Lewis' Woodpecker, discovered at Ellis, by Dr. L. Watson, and Yellow-crowned Night Heron, Blue Goose and the Common Tern, discovered in Southeastern Kansas by Colonel N. S. Goss, of Neosho Falls. The list now includes three hundred and two birds,and it is expected that this total will be increased to three hundred ard twenty-five in a few years. He here displayed the life-size figure of the skeleton of a fossil bird from Western Kansas. The skeleton stood six feet high, and its bill was armed with sharp teeth.

Dr. Thompson's paper on "The Antiquity of Man" was then read, in which it was shown that the problem of the antiquity of man must now be considerad from a geological standpoint. Although the Egyptians are a very ancient people, yet their history as a people is included in the present geological age, while skeletons of low forms of savages have been found in rock deposits which were formed at least one hundred thousand years ago.

A paper describing the huge extinct reptiles, *Dinosauria*, was read by Prof. Snow for the author, S. W. Williston, of Yale College. The dimensions of the largest skeletons show an animal of, in some cases, fifty feet in length. In the

vicinity of these are found skeletons of others of the same family, only twenty inches long.

Prof. Lovewell described the form of rain gauge used by him at Washburn College, and claimed, on good grounds, that he gained more absolutely correct results with this form of gauge than could be obtained with the ordinary form. This rain gauge is the invention of Prof. Nipher, of Washington University, St. Louis.

Mr. Savage described the lower jaw of a mastodon found in a clay bank along the Wakarusa, near Lawrence. No other remains were found in this locality, but Prof. Wm. Wheeler, of Ottawa, reported the finding of a portion of tusk, about six inches in diameter, in his vicinity. A careful search would probably disclose further specimens in the Eastern portion of the State.

Marcus Sayler, of Lawrence, read an entertaining paper on "Science Popularized," in which he showed that scientific knowledge is becoming a necessity to the successful prosecution of any branch of business. Science is knowledge systematically arranged. The artisan or the farmer who studies the scientific bearings of his pursuit will be the most successful.

As to the objection made by some of the materialistic tendencies of the study of science, the speaker claimed that no truer knowledge of the Creator could be obtained than through the study of his works and laws. Scientific education should begin in common schools, and the simplest principles of natural history should be taught to beginners. Thus would knowledge be gained and good mental discipline obtained at once.

A list of the fishes of the Maries des Cygnes river was read by the President in the absence of the author, Prof. Wm. Wheeler, of Ottawa.

This list includes nearly the same species as that published by Prof. Snow in the Fourth Agricultural Report. In the course of remarks upon the food fishes in Kansas, Hon. D. B. Long, Fish Commissioner for Kansas, stated that he would in the course of a few months introduce one hundred thousand California Salmon into Kansas rivers.

In his report on geological Explorations for the year 1878, Prof. Mudge gave a description of the lead and zinc region of Southwestern Kansas. The productive territory is an extent of about forty square miles, in triangular form. The professor will make a very full report in the forthcoming report of the State Board of Agriculture.

A paper entitled "Botanical Notes," read by E. A. Popenoe, gives a list of Shawnee county Plants, and numerous notes on the localities and distribution of Western Kansas plants, with some comparasons between the two plant districts of East and West Kansas.

Prof. C. D. Merrill, of Washburn College, favored the Academy with a pleasant description of Fingal's Cave and Giant's Causeway, two remarkable geological formations in Scotland and Ireland, giving descriptions of the geological features, with remarks on the probable connection between the two, which are similar formations.

Prof. Lovewell, of Washburn College, in a paper on the Electrical transmission of sound, gave a history of the growth of the telephone, from the instrument formed by stretching a piece of sausage skin across the open bung of a beer keg, to the present instruments of Bell and Edison. The Professor is an original investigator in the field of the telephone.

The papers on the programme having all been read, the report of the Committee on Nominations was presented, and the election of the officers, in accordance with nominations reported, resulted as follows:

President, B. F. Mudge; Vice Presidents—J. H. Carruth and Joseph Savage; Secretary, Edwin A. Popenoe; Treasurer, R. J. Brown; Curators, F. H. Snow, B. F. Mudge, E. A. Popenoe.

The following Commissions were also appointed:

Geology—B. F. Mudge, M. V. B. Knox; Chemistry and Mineralogy—W. K. Kedzie, G. E. Patrick, R. J. Brown; Physics—J. T. Lovewell, L. A. Thomas; Zoölogy—F. H. Snow, M. V. B. Knox, Annie E. Mozley; Botany—J. H. Carruth, E. A. Popenoe; Entomology—F. H. Snow, E. A. Popenoe, Geo. F. Gaumer, William Osborn, T. B. Ashton; Anthropology—A. H. Thompson, J. D. Parker, F. G. Adams; Philology—D. H. Robinson, Geo. Stearns; Meteorology—J. D. Parker, J. T. Lovewell; Committee on Publications—B. F. Mudge chairman, Alfred Gray, F. H. Snow; Committee on Local Arrangements—E. A. Popenoe, F. G. Adams, A. H Thompson, Mrs. N. C. McFarland.

In retiring from the chair of the President, which he has held for five successive vears, Prof. Snow remarked upon the very satisfactory growth and evident prosperity of the Academy, prophesying for it an increasing reputation and usefulness, and a prominent place among the institutions of the State.

A vote of thanks was offered the retiring President for the unswerving fidelity and indéfatigable efforts which he had exercised in behalf of the Academy, after which adjournment was made to the hour of the evening lecture in the Baptist Church.

The evening lecture was delivered by Prof. D. H. Robinson of the State University, who amplified his subject, "The Historical Value of Linguistic Study," in a manner that pleased and entertained every one of the large audience. The subject is one of unusual interest and was well handled by Prof. Robinson, who traced familiar words in our language through various changes back to the original and and often much more expressive word in a language now no longer heard.

He explained also how similarity in the grammatical structure of two different languages pointed to a community of origin, although the resemblance would not show itself in words of like sound. He gave a brief and interesting history of the growth of the present English language, adverting to the different foreign elements that were from time to time introduced, and which modified, in some instances greatly modified, the essential structure.

The lecture was upon a subject fully within the scope of the Academy of Science, and which has received too little attention in the past and deserves fuller recognition in the future.

After the close of the well written and pleasantly delivered lecture, a vote of thanks was offered by members of the Academy, to the people of Topeka for their hospitality and interest in the meetings; to the officers of the Baptist Church for the use of their building for the evening lectures; and to the daily papers of Topeka for the generous manner in which they advertised the meetings of the Academy. After this the meeting was adjourned subject to the call of the Executive Committee, who are empowered to appoint time and place of next Summer's semi-annual meeting.

The sessions were, throughout, well attended, and the interest was fully equal to that evinced on any previous occasion. The number of papers presented —twenty-five—is a marked advance over the number of any previous year, and it will soon be necessary to hold the meetings two entire days instead of parts of two as at present.

THE COURSE OF NATURE.

BY PROF. SIMON NEWCOMB, WASHINGTON, D. C.

(*Concluded from September number.*)

When Pallas inspired Diomed with renewed strength, and gave superhuman accuracy to his aim, it was in order that he might be able to pierce his Trojan enemies. Ordinary investigation might fail to show that his hand trembled less than usual as he raised his javelin, but the goddess took care that the last quiver, as the weapon left his hand should be in the direction to send it into the breast of the foe. The utterances of the oracles were determined, not by the past or the present, but by events still in the future. The blazing comet appeared, not in obedience to a chain of causes commencing with the creation, but in order that man might be warned of the coming calamity. When the prayers of the righteous averted the coming storm, the cloud moved aside in order that their fields and houses might be saved, and when they brought down the gentle rain upon the parched fields, the rain fell in order that famine might be averted.

These supposed causes differed from what enlightened minds now understand by the term Providence in being amenable to scientific investigation, and in not being included in the regular chain of natural phenomena. The designs of Providence are inscrutable, but those of Pallas and Juno were not. Careful experimental investigation, such as might have been undertaken by a Helmholtz of that time would have sufficed to show just how Pallas wanted the spear thrown, if the view of the Homeric age was the correct one. When the king died or the enemy was victorious, men thought they knew exactly why the comet appeared when it did.

These views having so far vanished into thin air, I do not see how we can avoid recognizing the reality of the revolution which modern science claims to have made in the views of men respecting the course of nature. And yet, as I have already shown, there are many tendencies in our being which make us unwilling

to admit the revolution, and lead many to look upon the old theory as correct, provided it were only considered as tracing causes to the will of the Creator. On what is this view founded at the present time? Entirely, it seems to me, in ignoring the distinction between the scrutable and the inscrutable, between the seen and the unseen worlds. Science has, to a greater or less degree, banished final causes from the visible universe, but they act with undiminished vigor in the invisible one. Such a translation may not be a great revolution in thought from a theological point of view, but it certainly is from a scientific standpoint, which considers only visible things.

I can readily imagine your asking if teleological causes can be readily considered as absolutely banished from the whole domain of visible nature; if, considering how limited our knowledge, and how vast that part even of the visible universe which we do not know, it is not rash to assert that we know the true theory of nature, even in the field of phenomena. This question may lead us to look a little more carefully than we have hitherto done upon the exact standing of the doctrine of the uniform course of nature according to antecedent causes and the relation of this doctrine to modern scientific investigation. And this leads me to say that it would be entirely unphilosophical to regard the revolution I have described as a scientific discovery or induction. It may be doubted whether the scientific mind is really any less disposed to believe in final causes than the ordinary mind. Nor can the theory that the course of nature is symbolized by the chain of cause and effect, as I have described it, be considered as the product of modern investigation simply, or as belonging especially to the present age. It is a theory which has been, in a limited sphere, recognized by all men at all times. The reason why modern science has so greatly extended its scope is that modern science has acquired a vastly more extended view of nature than has before been obtained. We all know full well that the action of teleological causes has always been ascribed to operations into which human investigation could not penetrate, although their ultimate effects might be plainly seen. Whenever the subject becomes so well understood that the chain of natural causes can be clearly followed, miracles and final causes cease, so far as the scientific explanation of things is concerned. That a ball or spear thrown in one direction would bend its course into an entirely different direction no one ever supposed. Homer never imagined Pallas as changing the course of the javelin after it had left the hand of Diomed. But those states of the nervous system which result in a certain and accurate aim, or in a tremulous or uncontrolled arm, lay beyond the pale of physiological knowledge in the time of Homer, so here it was that the goddess intervened. When nervous action became fully understood the final cause receded and took refuge in some deeper arcanum of our ignorance. Jove was never expected to make thunder and rain without clouds, nor was the falling of the rain ever ascribed to his interference, because every one believed that if the drops were once formed they would fall at once to the ground without any action on his part. But the mixing currents of moist and cool air, and the processes of condensation which leads to the formation of rain and electricity, were not understood, so here

Jupiter had a chance to work unseen by man. When the mode in which clouds were formed was once understood, the god of thunder left his seat upon Mount Olympus for a more distant abode. From the earliest historic times the man who took a large dose of poison has died, as a matter of course; neither good nor evil spirit had anything to do with it. But if brain disease bereft him of reason the malevolence of an evil spirit was called into account for the result. If the best man now living should draw up plans and specifications for a dwelling, and then try to induce Providence to erect it in a night, complete in all its parts without further action on his part, we should look upon him as not less remarkable for the feebleness of his intellect than for his moral excellence. We should tell him that he was expecting a miracle, and that the age of miracles was past. But, it would not seem absurd should he appeal to Providence for a showery rain to facilitate the growth of his garden vegetables, because the effect would not appear at all miraculous.

It thus appears that the dividing line between mechanical and final causes, as drawn by the human mind in all ages, has not been fixed in any absolute manner, but only near the limits of the knowledge possessed by each generation. Science has extended the line entirely beyond ordinary mental vision, not by introducing any new theory of nature, but by extending the boundaries of exact knowledge, and with them the field in which, by common consent, final causes do not admit of being traced.

The telescope has revealed to us a universe compared with which that known to ancients is but an atom, and geology has opened up to our view a vista of ages in which the lifetime of our generation is hardly more than a moment. And thus, final causes have taken their flight from a vast region in which they before lay hid in obscurity. The fall of a simple drop of rain at any future time, in any other way than that of exact accordance with the chain of causes now and always in operation would be as complete a miracle as would the appearance of a building without the intervention of human hands. You may now ask, have they simply taken refuge in the more distant, but vastly wider circumference which now marks the boundaries of our knowledge, or are we to suppose them entirely banished from nature? This is entirely a question of intuition and not at all of scientific investigation. I have described the scientific theory of nature as not admitting scrutable final causes at all, but as claiming that the law of the falling rock is symbolic of all her operations. But I think this is a view toward which philosophers have alway inclined.

We must alway expect that men will incline to this view in proportion to their familiarity with the material side of nature. At the same time it is evident to all that there must have been a beginning of things, and that nature could not have commenced herself. We have therefore, a wide belt left between the origin of nature and the boundaries of our knowledge in which we may suppose the inscrutable cause to have acted. Here we reach questions of philosophy which lie outside of our field, and which, therefore, we cannot now stop to con-

sider. The exact bearing of the subject will be better understood by condensing the whole in a brief space.

1. When men study the operations of the world around them they find that certain of those operations are determined by knowable antecedent conditions, and go on with that blind disregard of consequences which they call law. They also find certain other operations which they are unable thus to trace to the operation of law.

2. Men attribute this latter class to intelligent anthropomorphic beings, or gods, having the power to bring about changes in nature, and having certain objects, worthy or ignoble, in view, which they thus endeavor to compass. Men also believe themselves able to discern these objects, and thus to explain the operations which bring them about. The objects are worthy or ignoble according to the state of society. In ancient times they were often the gratification of the silliest pride or the lowest lusts.

3. As knowledge advances, one after another of these operations are found to be really determined by law, the only difficulty being that the law was before unknown or not comprehended, or that the circumstances which determined its action were too obscure or too complex to be fully comprehended.

4. Final causes have thus, one by one, disappeared from every thicket which has been fully explored; the question arises whether they now have or ever had any existence at all. On the one hand, it may be claimed that it is unphilosophical to believe in them when they have been sought in vain in every corner into which light can penetrate. On the other hand, we have the difficulty of accounting for these very laws by which we find the course of nature to be determined. Take, as a single example, the law of hereditary descent. How did such a law—or, rather, how did such a processs, for it is a process—first commence? If this is not as legitimate a subject for inquiry as the question "How came the hand and the eye into existence?" it is only because it seems more difficult to investigate. If, as the most advanced scientific philosophy teaches, creation is itself but a growth, how did that growth originate? We here reach the limits of the scientific field, on ground where they are less well defined than in some other directions, but I shall take the liberty of concluding my remarks with a single suggestion respecting a matter which lies outside of them. When the doctrine of the universality of natural law is carried so far as to include the genesis of living beings and the adaptations to external circumstances which we see in their organs and their structure, it is often pronounced to be atheistic. Whether this judgment is or is not correct I cannot say, but it is very easy to propound the test question by which its correctness is to be determined. Is the general doctrine of causes acting in apparently blind obedience to invariable law in itself atheistic? If it is, then the whole progress of our knowledge of nature has been in this direction, for it has consisted in reducing the operations of nature to such blind obedience. Of course. when I say blind, you understand that I mean blind so far as a scrutable regard to consequence is concerned—blind like justice, in fact. If the doctrine is not atheistic, then there is nothing atheistic in any phase of the theory

of evolution, for this consists solely in accounting for certain processes by natural laws I do not pretend to answer the question here involved, because it belongs entirely to the domain of theology. All we can ask is that each individual shall hold consistent views on the subject, and not maintain the affirmative of the question on one topic and the negative on another. My object in presenting the views I have, has been not so much to propound a new theory as to promote consistency of views among the laborers in the scientific field.

ARCHÆOLOGY.

ANCIENT POTTERY FOUND IN MISSOURI MOUNDS.

BY A. J. CONANT, A. M., ST. LOUIS.

The number of vessels of pottery which have been taken from the mounds in Missouri is prodigious, and almost endless in variety. In an instance which fell under my own observation, nearly, if not quite, one thousand pieces were obtained from a single burial mound; and these were of various sizes and great diversity of form and workmanship. Some of the most characteristic examples will be presented as we proceed. The skill displayed by the pre-historic Americans in everything they manufactured from common clay is vastly superior to that of the ancient civilizations of Europe, to which, in other respects many striking similarities may be traced.

From the fact that few articles which are the products of human ingenuity and skill are more enduring than earthen-ware, this class of antiquities, to the archæologist, is very interesting and instructive. The skill and taste displayed in its various imitative forms, in outline and decoration, give us an insight into some phases of domestic life, social condition and æsthetic taste of ancient peoples, which can be derived from no other source. Fragments of pottery, to the archæologist, therefore, are the imperishable leaves of a book, inscribed by the truthful hand of humanity, in legible characters, with the precious records of those feelings and tender sentiments which are recorded nowhere else, and which need no translation. Their value is enhanced so much the more by the fact that we possess specimens of these records from every quarter of the globe, and coeval with the remotest civilizations.

The successful attempts of the ancient Americans to imitate the forms of beasts and birds, which they saw every day around them, evince a contemplation, observation and affectionate communion with nature which fills us with surprise.

In reference to the superiority of the skill displayed by the Mound-builders in the ceramic arts, to the corresponding civilization of ancient Europe, I can not do better than quote the words of Dr. Foster.*

"In the plastic arts, the Mound-builders attained a perfection far in advance of any samples which had been found characteristic of the Stone and even the Bronze Age of Europe. We can readily conceive that, in the absence of metallic vessels, pottery would be employed as a substitute, and the potter's art would be held in the highest esteem. From making useful forms, it would be natural to advance to the ornamental. Sir John Lubbock remarks that 'few of the British sepulchral urns, belonging to the ante-Roman times, have upon them any curved lines. Representations of animals and plants are almost entirely wanting.' They are even absent from all the articles belonging to the Bronze Age in Switzerland, and I might almost say in Western Europe generally, while ornaments of curved and spiral lines are eminently characteristic of this period. The ornamental ideas of the Stone Age, on the other hand, are confined, so far as we know, to compositions of straight lines, and the idea of a curve scarcely seems to have occurred to them. The most elegant ornaments on their vases are impressions made by the finger nails, or by a cord wound around the soft clay.

"The commonest forms of the Mound-builders' pottery represent kettles, cups, water-jugs, pipes, vases, etc., etc. Not content with plain surfaces, they frequently ornamented their surfaces with curved lines and fret-work. They even went farther, and moulded images of birds, quadrupeds, and of the human form. The clay, except for their ordinary kettles, where coarse gravel is often intermixed, is finely tempered, so that it did not warp or crack in baking,—the utensils, when completed, having a yellowish or grayish tint."

In the group of vessels shown in Fig. 1, while the human faces and heads of birds are crudely expressed, we find much to admire in the tasteful forms of the objects themselves, The flow of their outline, so to speak, evinces a degree of refinement of feeling which could only result from a culture of the sense for beauty, which must have required a long time for its realization. It will be noticed that the mouths or openings were, on all, made at the back side of the head. This seems to have been the uniform practice, whether the head of the vessel was that of man, beast or bird. Sometimes the vessels with vertical openings, are fitted with covers of the same material, with projecting knobs on the top for handling them. Sometimes, again, the smaller jugs, or bottles as they should be called, have nicely-adjusted stoppers. These latter bottles are made of much finer material, and while they are generally quite thin, they are so well baked that they seem to be almost as tough and strong as our own ware. On page 23 of the Eighth Annual Report of the Trustees of the Peabody Museum, a representation of two of these stoppers is given. They are described as "two articles carved from a hard clay slate and carefully smoothed. Their use is problematical, but they so closely resemble lip ornaments as to suggest that they were such." These are now in the "Swallow Collection" of the museum. In its transportation from

*Pre-historic Races of the United States, p. 236.

Missouri to Massachusetts, the report informs us, many of the articles were so broken as to make their reconstruction impossible. When I had the pleasure of examining this collection, some years since, these stoppers were then attached to the bottles with which they were found. The smaller bottle of the two, Professor Swallow informed me, when taken from the mound, contained a red liquid.

Some of the representations of the human figure are executed with a good degree of fidelity to nature, through all the members; showing that the artist had studied carefully his model, and had evidently labored to tell the truth as he saw it. Some of the human figures have an expression so striking and individual that we can hardly

Fig. 1.

believe that they are not portraits. This becomes more probable when we examine the animal representations, or rather the heads of birds, with which the pottery is very often ornamented; particularly those of the different varieties of ducks, in which we observe in the shape of the head, line of neck, etc., the nicest distinctions in particular varieties, which are expressed with remarkable skill. This will be apparent when we come to the consideration of Food Vessels.

Their imitative faculties, as illustrated in their pottery, were certainly remarkable, and to give an adequate idea of the variety of their work in the subjects which might be chosen for illustration would require more space than is allotted to this essay. We proceed, therefore, to consider their cooking utensils. One of the more frequent forms is shown in Fig. 2.

While these vessels were doubtless for common, every-day use, some of

Fig. 2.

them are really quite artistic and graceful. The forms and ornamentation of the others seem to be more experimental, and perhaps transitional, as though the maker varied a little from his usual manner just to see how they would look. It will be observed that all have two or more handles, by which they were probably suspended over the fire by passing through them green twigs, which they covered with moist clay to prevent them from burning. Examples might be multiplied, *ad infinitum*, almost, of this class of vessels, but the above is sufficient to illustrate the inventive powers of their authors in this direction, as well as their constant striving to gratify their æsthetic feeling in the manufacture of those fragile articles which were designed for the commonest uses.

Fig. 3.

Fig. 3 represents a pot very similar to one of the latter, but entirely unique in this, that it contained the upper portion of a human skull and one vertebra. It was taken from a mound near New Madrid, by Prof. Swallow, who tells us that the vessel must have been moulded around the skull, as it could not be removed without breaking the pot. It is now in the Peabody Museum. The top of the skull is shown in the engraving. This is certainly a curiosity. Nothing like it has been found in any other burial mound here or anywhere else, as far as known. It may be remembered, however, in this connection, as before remarked, that small pots have frequently been found in the larger pans, and which contained a decayed shell or fragment of bone. These were, very likely, valued relics or charms which were buried with their possessor.

Fig. 4.

In the next cut (Fig. 4) is presented one of the most common of varieties another and quite different class of bowls. They are peculiar in this: the bodies of of the vessels are entirely devoid of ornamentation. From the edge of the lip on one side projects a small handle; on the opposite side is moulded the head of some beast or bird, and quite often a human head is represented.

The thing specially to be noticed is the diversity of form in the heads of the ducks. So faithfully are the distinctive features of the different varieties delineated, that those at all familiar with them must believe that the artist, according to the best of his skill, conscientiously copied nature. The beautiful curve of the neck and its union with the outline of the vessel itself, could not possibly have been accidental.

The best which these ancient workmen could do is so far inferior to the art of our own times, that it is not easy for us to appreciate the difficulties they must have overcome, their many failures, the long time necessary for the acquisition of those habits of observation, and the development of the skill of hand sufficient to enable them to express themselves as creditably as they have done in all their imitative work. In the class of vessels under consideration, examples decorated with the human head and features are by no means rare. If the credit given them for conscientious observation of nature, and skill in expression of what they saw, is not an over-estimate, then we may believe that, in their delineation of the human face, they also copied nature with a sufficient degree of accuracy to warrant us in the idea that in their work we have at least characteristic likenesses of themselves.

The necessity for condensation demands that here our consideration of this part of our subject should end. The variety and beauty of many of the objects of their fictile skill are very suggestive, and furnish much material for extended generalization. But a remark or two must suffice in this connection. To suppose that all this taste and feeling—this close observation of nature and fidelity in delineation, displayed in the pottery of the Mound-builders, found no expression in any other direction, and was expended upon their domestic utensils alone, is simply incredible. Very different must have been the homes of a people furnished with such tasteful articles, from those miserable huts which the nomadic Indians constructed for their habitations; and it is quite likely that in their dress as well as their dwellings they evinced the same ideas of taste and convenience which we perceive in their domestic utensils. In some of their human effigies we do find the manner of arranging the hair distinctly delineated, and we may yet discover those which shall furnish us with correct representations of their mode of dress. Indeed I have seen one vessel with figures of men rudely painted in outline upon its sides, who were clad in a flowing garment, gathered by a belt around the waist, and reaching to the knees. In this connection I may mention the engraved shells which have frequently been found with skeletons, both in Missouri and Illinois. One of the most interesting was furnished by the late Captain Whitley. When taken from the mound the shell was quite soft and brittle, and easily cut with the finger-nail. The outer edge was much broken or worn away. The design was inclosed by six circular lines, portions of which still remain. On one side were two perforations, designed, doubtless, for the string by which it was suspended from the neck. All similar shells that I have seen are so perforated. It seems quite evident from the picture that it memoralizes the victory of the individual represented as standing over an enemy, who lies on his face at his feet.

The victor, it will be observed, holds in his right hand a weapon or symbol of authority, with which he seems to be pressing the prostrate figure to the earth. Many of the accessories are unintelligible. While the whole work is very crude, and the figures out of all proportion, there is here and there an outline which shows earnest endeavor; as the leg of the standing figure, for example, in which also the action is so well expressed as to suggest that, by an impetuous onset, he has just felled his antagonist to the ground. The artist seems to have had most difficulty with the eye, or rather, has made no attempt at imitating that organ.

There is now in the museum of the St. Louis Academy of Science, a similar shell, upon which is portrayed, in a creditable manner, the figure of a spider. I have also been shown another by Dr. Richardson, from a mound in Illinois, almost precisely like it, and differing only in a small symbolic device, which is carved upon the back of each. Engraved shells are generally found upon the breast of the skeleton, or in such a position as shows that they were originally placed there, and also where they were probably worn during life. According to Mr. Pidgeon, the spider emblem is perpetuated in the mounds far to the north. He describes one which he saw in Minnesota, about sixty miles above the junction of the St. Peters river with the Mississippi, which covered nearly an acre of ground. Upon ascending its highest elevation, he tells us, it was very evident that the spider was intended to be represented by it. I bring these facts together for the benefit of future observers, without speculating as to their significance, further than to venture the remark that they point to a great diffusion of one people, or their migration from the north, southwardly along the Mississippi valley.—*Commonwealth of Missouri.*

SCIENTIFIC MISCELLANY.

THE AERONAUTIC FLIGHT OF SPIDERS.

Many observations have been made on this singular phenomenon, but hitherto with little success. An English naturalist, the Rev. H. McCook, has for some time past, turned his attention to the subject, and has succeeded in detecting many new details in the performance. Very recently he watched some groups of young wolf-spiders (*Lycosidæ*), which crowded the tops of railings in a meadow. Their faces were turned in the direction from which the wind was blowing; the body of each was elevated to an angle of 45°; the claws brought together and the legs stiffened. From the spinnerets at the apex of the abdomen a single thread was exuded, and rapidly drawn out to a length of several feet by the breeze. Gradually, the foremost pair of legs sank to the level of the wood, and the entire attitude was that of intense resistance. Then, suddenly and simultaneously, the eight claws were unloosed, and the spider mounted, with a sharp bound, into the air, and went careering across the field. As far as could

be judged, the insect seemed to take a voluntary leap at the moment of loosing its hold. One of them, by good fortune, was followed through its flight. The position of the body was soon reversed, the head being turned in the same direction as the wind. The legs were spread out and were united at the claws by delicate filaments of silk. After flying a distance of about eighty feet, the spider gradually settled down on the meadow. The difficulty of these observations will be readily understood, for they require exact suitability of position as to light, the limitation of the flight to a moderate height, and a comparatively slow speed. —*Boston Journal of Chemistry.*

THE PROBLEM OF THE ORIGIN OF LIFE.

And, now, what has become of this most vexed problem of problems—the origin of life? Is not protoplasm a chemical compound like other substances, merely varying from them in its degree of molecular complexity? Its most characteristic manifestation, its distinguishing mode of motion, its peculiar force—the one specific activity constituting its most vital difference—is better known to us than any quality which forms the distinguishing feature between other substances. Do we greatly concern ourselves of the origin of $MgO, SO_3 + 7H_2O$, or any other mineral substance? Why, then, should the origin of some combination of C, H, N, O, be made a question of the life and death of our principal philosophies? Has it actually come to this, that the scientific foundation of our creed rests on the decision whether COO is or was once changed into CHO by natural or supernatural means; and this when there is plenty of H about in our world? Yes, it is even so, however incredible, however little flattering to our intellectual pretensions. The contending claims of naturalism and supernaturalism, the fate of the most momentous question touching the guidance of our life, turn actually, in the field of science, upon the paltry issue of the synthesis of ternary carbon compounds, whether this be chemically or whether it be superchemically effected. COO is indisputably an inorganic compound. CHO is indisputably an organic compound. This designates accurately the actual depth of the gulf existing between organic and inorganic Nature.—Dr. Montgomery, in *Popular Science Monthly for October.*

Formation of Whirlwinds.—In Hebert's recent communications to the French Academy, he has laid special stress upon the influence of the land configurations, and especially of the mountains and valleys, upon the great movements of the atmosphere. He comes to the conclusion that all the cyclones which visit Europe from the Atlantic Ocean originate in the American mountains. Many years ago Professor Henry indicated the region of the Saskatchawan as a prominent cradle of storms. More recent communications to the American Philosophical Society, based partly upon the observations of the Signal Service Bureau and partly upon special meteorological records at San Francisco and at Barbadoes, have shown that there are two other important centers of extensive atmospheric disturbance: one in the neighborhood of Colorado, and another in the West India Islands.—*Jour. Franklin Institute.*

GEOGRAPHY.

CONGRESS AND THE NORTH POLE.

AN ABSTRACT OF ARCTIC LEGISLATION IN THE CONGRESS OF THE UNITED STATES.

BY CAPTAIN H. W. HOWGATE, U. S. A., WASHINGTON, D. C.

The recent revival of interest in the subject of Arctic Exploration, in connection with the proposed establishment of a Scientific Colony on the shore of Lady Franklin Bay, under the auspices of the United States Government, naturally awakens a desire to know what part the government has taken in the previous expeditions that have been sent out from the United States to the Arctic for the relief of Sir John Franklin or for geographical exploration and discovery. It is to gratify this desire that I have compiled the series of papers of which this forms the first, from official reports and other public documents through which the records are scattered. I make no attempt at a history of the expeditions themselves, but simply aim to show how they originated and obtained government sanction and aid.

I.

THE DE HAVEN, OR FIRST GRINNELL EXPEDITION.

The first American expedition to the Arctic for other than commercial purposes, and to which the government lent a helping hand, was that known as the First Grinnell Expedition, and inspired by Lady Franklin in her noble efforts to enlist the coöperation of the world in the search for her lost husband. The following message from Gen. Taylor, then President of the United States, to Congress, communicating copies of a correspondence with Lady Franklin on the subject, together with the letters referred to, show the desire of the Executive to respond favorably to the touching appeal, and the cause that had prevented action. The message was read in the Senate January 4, 1850, and referred to the Committee on Naval Affairs and ordered to be printed.

To the Senate and House of Representatives of the United States:

I herewith submit to you copies of a correspondence with the lady of Sir John Franklin, relative to the well known expedition, under his command, to the Arctic regions, for the discovery of a northwest passage. On the receipt of her first letter imploring the aid of the American Government in a search for the missing ships, engaged in an enterprise which interested all civilized nations, I anxiously sought

the means of affording that assistance, but was prevented from accomplishing the object I had in view, in consequence of the want of vessels suitable to encounter the perils of a proper exploration, the lateness of the season, and the want of an appropriation by Congress to enable me to furnish and equip an efficient squadron for that object. All that I could do, in compliance with a request which I was deeply anxious to gratify, was to cause the advertisements of reward promulgated by the British Government, and the best information I could obtain as to the means of finding the vessels under the command of Sir John Franklin, to be widely circulated among our whalers and sea-faring men, whose spirit of enterprise might lead them to the inhospitable regions where that heroic officer and his brave followers, who periled their lives in the cause of science and for the benefit of the world, were supposed to be imprisoned among the icebergs, or wrecked upon the desert shore. Congress being now in session, the propriety and expediency of an appropriation for fitting out an expedition to proceed in search of the missing ships, with their officers and crews, is respectfully submitted to your consideration.

Z. TAYLOR.

WASHINGTON, Jan. 4, 1850.

CORRESPONDENCE.

LADY FRANKLIN TO THE PRESIDENT.

BEDFORD PLACE, LONDON, April 4, 1849.

Sir:—I address myself to you, as the head of a great nation whose power to help me I cannot doubt, and in whose disposition to do so I have a confidence which I trust you will not deem presumptuous.

The name of my husband, Sir John Franklin, is probably not unknown to you. It is intimately connected with the northern part of that continent of which the American Republic forms so vast and conspicuous a portion. When I visited the United States, three years ago, amongst the many proofs I received of respect and courtesy, there was none which touched and even surprised me more than the appreciation everywhere expressed to me of his former services in geographical discovery, and the interest felt in the enterprise in which he was then known to be engaged.

The expedition fitted out by our government for the discovery of the North-west passage, (that question which, for three hundred years, has engaged the interest and baffled the energies of the man of science and the navigator), sailed under my husband's command in May, 1845. The two ships—"Erebus" and "Terror"—contained one hundred and thirty-eight men (officers and crews), and were victualed for three years. They were not expected home, unless success had early rewarded their efforts or some casualty hastened their return, before the close of 1847, nor were any tidings expected from them in the interval. But when the autumn of 1847 arrived without any intelligence of the ships, the attention of her Majesty's government was directed to the necessity of searching for and conveying relief to them in case of their being imprisoned in ice, or wrecked and in want of provisions and means of transportation.

For this purpose an expedition in three divisions was fitted out in the early part of last year, directed to three different quarters simultaneously, viz: 1st, To that by which in case of success the ships would come out of the Polar Sea to the westward, or Behring's Strait; 2nd, to that by which they entered on their course of discovery on the eastern side, or Davis' Strait; and 3rd, to an intervening portion of the Arctic shore approachable by land from the Hudson Bay Company's settlements, on which it was supposed the crews, if obliged to abandon their ships, might he found. This last division of the expedition was placed under the command of my husband's faithful friend, the companion of his former travels, Dr. Sir John Richardson, who landed at New York in April of last year, and hastened to join his men and boats, which were already in advance toward the Arctic shore. Of this portion of the expedition I may briefly say that the absence of any intelligence from Sir John Richardson at this season proves he has been unsuccessful in the object of his search.

The expedition intended for Behring's Strait has hitherto been a complete failure. It consisted of a single ship, the "Plover," which, owing to her setting off too late, and to her bad sailing properties, did not even approach her destination last year.

The remaining and most important portion of the searching expedition consists of two ships under the command of Sir James Ross, which sailed last May for Davis' Strait, but did not succeed, owing to the state of the ice, in getting into Lancaster Sound until the season for operations had nearly closed. These ships are now wintering in the ice, and a store ship is about to be dispatched from hence with provisions and fuel to enable them to stay out another year; but one of these vessels is, in a great degree, withdrawn from active search by the necessity of watching at the entrance of Lancaster Sound for the arrival of intelligence and instructions from England by the whalers.

I have entered into these details with the view of proving that though the British government has not forgotten the duty it owes to the brave men it has sent on a perilous service, and has spent a very large sum in providing the means for its rescue, yet that, owing to various causes, the means actually in operation for this purpose are quite inadequate to meet the extreme exigence of the case; for, it must be remembered, the missing ships were victualed for three years only, and that nearly four years have now elapsed, so that the survivors of so many winters in the ice must be at the last extremity. And also, it must be borne in mind that the channels by which the ships may have attempted to force a passage to the westward, or which they may have been compelled by adverse circumstances to take, are very numerous and complicated, and that one or two ships cannot possibly, in the course of the next short summer, explore them all.

The Board of Admiralty, under a conviction of this fact, has been induced to offer a reward of £20,000 sterling to any ship or ships, of any country, or to any exploring party whatever, which shall render efficient assistance to the missing ships or their crews, or to any portion of them. This announcement, which, even if the sum had been doubled or trebled, would have met with public approbation,

comes, however, too late for our whalers, which had unfortunately sailed before it was issued, and which, even if the news should overtake them at their fishing grounds, are totally unfitted for any prolonged adventure, having only a few months' provisions on board and no additional clothing. To the American whalers, both in the Atlantic and Pacific, I look with more hope as competitors for the prize, being well aware of their numbers and strength, their thorough equipment and the bold spirit of enterprise which animates their crews. But I venture to look beyond even these. I am not without hope that you will deem it not unworthy of a great and kindred nation to take up the cause of humanity which I plead, in a national spirit, and thus generously make it your own.

I must here, in gratitude, adduce the example of the imperial Russian government, which, as I am led to hope by his Excellency, the Russian Ambassador in London, who forwarded a memorial on the subject, will send out exploring parties this summer, from the Asiatic side of Behring's Strait northward, in search of the lost vessels. It would be a noble spectacle to the world, if three great nations, possessed of the widest empires on the face of the globe, were thus to unite their efforts in the truly Christian work of saving their perishing fellow-men from destruction.

It is not for me to suggest the mode in which such benevolent efforts might best be made. I will only say, however, that if the conceptions of my own mind, to which I do not venture to give utterance, were realized, and that in the noble competition which followed, American seamen had the good fortune to wrest from us the glory, as might be the case, of solving the problem of the unfound passage, or the still greater glory of saving our adventurous navigators from a lingering fate which the mind sickens to dwell on, though I should in either case regret that it was not my own brave countrymen in those seas whose devotion was thus rewarded, yet should I rejoice that it was to *America* we owed our restored happiness, and should be forever bound to her by ties of affectionate gratitude.

I am not without some misgivings while I thus address you. The intense anxieties of a wife and of a daughter may have led me to press too earnestly on your notice the trial under which we are suffering, (yet not *we* only, but hundreds of others,) and to presume too much on the sympathy which we are assured is felt beyond the limit of our own land. Yet if you deem this to be the case, you will still find, I am sure, even in that personal intensity of feeling, an excuse for that fearlessness with which I have thrown myself on your generosity, and will pardon the homage I thus pay to your own high character, and to that of the people over whom you have the high distinction to preside.

I have the honor to be, sir, with great respect,

Your obedient servant,

JANE FRANKLIN.

MR. CLAYTON TO LADY FRANKLIN.

DEPARTMENT OF STATE, WASHINGTON, April 25, 1849.

Madam:—Your letter to the President of the United States, dated April 4, 1849, has been received by him, and he has instructed me to make to you the following reply:

The appeal made in the letter with which you have honored him, is such as would strongly enlist the sympathy of the rulers and the people of any portion of the civilized world. To the citizens of the United States, who share so largely in the emotions which agitate the public mind of your own country, the name of Sir John Franklin has been endeared by his heroic virtues and the sufferings and sacrifices which he has encountered for the benefit of mankind. The appeal of his wife and daughters, in their distress, has been borne across the waters, asking the assistance of a kindred people, to save the brave men who embarked in his unfortunate expedition, and the people of the United States, who have watched with the deepest interest that hazardous enterprise, will now respond to that appeal by the expression of their united wishes that every proper effort may be made by this government for the rescue of your husband and his companions.

To accomplish the objects you have in view, the attention of American navigators, and especially of our whalers, will be immediately invoked. All the information in the possession of this government to enable them to aid in discovering the missing ships, relieving their crews and restoring them to their families, shall be spread far and wide among our people, and all that the executive government of the United States, in the exercise of its constitutional powers, can effect to meet this requisition on American enterprise, skill and bravery, will be promptly undertaken.

The hearts of the American people will be deeply touched by your eloquent address to their Chief Magistrate, and they will join with you in an earnest prayer to Him whose spirit is on the waters, that your husband and his companions may yet be restored to their country and their friends.

I have the honor to be very respectfully, madam,

Your obedient servant,

JOHN M. CLAYTON.

Lady Jane Franklin.

LADY FRANKLIN TO THE PRESIDENT.

BEDFORD PLACE, LONDON, May 24th, 1849.

Sir:—The letter with which you have kindly honored me, conveying the reply of the President of the United States to the appeal I ventured to address him in behalf of the missing Arctic expedition under my husband's command, has filled my heart with gratitude and excites the liveliest feelings of admiration in all who have had an opportunity of seeing it.

Relying upon the reports in the American papers just received, I learn that the people of the United States have responded, as you foresaw they would, to the appeal made to their humane and generous feelings, and that in a manner

worthy of so great and powerful a nation—indeed, with a munificence which is almost without a parallel.

I will only add that I fully and firmly rely upon the wisdom and efficiency of the measures undertaken by the American government. I beg you to do me the favor of conveying to the President the expression of my deep respect and gratitude, and I trust you will accept yourself my heartfelt acknowledgments for the exceedingly kind and feeling manner in which you have conveyed to me His Excellency's sentiments. I have the honor to be, sir,

Your obliged friend and obedient servant,

JANE FRANKLIN.

MR. CRAMPTON TO MR. CLAYTON.

WASHINGTON, June 2, 1849.

Sir:—I have been directed by Her Majesty's government to lose no time in communicating to the government of the United States the printed papers, which I have the honor to inclose herewith, in case an intention on their part, referred to in a statement which appeared in the *Times* newspaper of the 22d ultimo, of sending two ships in search of Sir John Franklin's expedition, is really entertained, it having been suggested by the Lords of the Admiralty that, in that case, it may be useful that the United States government may be in possession of these papers, containing the views of officers competent to give an opinion as to the best chances for affording relief to the expedition, and the steps taken by Her Majesty's government for that purpose.

Her Majesty's government,are,ere this,apprized of the reality of the liberal and philanthropic intention of the President with regard to the expedition in question, which I had the honor of reporting to Viscount Palmerston, in a dispatch dated the 14th ultimo. I have, therefore, the satisfaction of being enabled now to fulfill the instruction which has been addressed to me in anticipation of the correctness of the statement, which had already reached Her Majesty's government, by expressing to you, sir, their full appreciation of the generous and humane motives which have induced the government of the United States to send an expedition to the Arctic seas.

I avail myself of this opportunity to return to you, sir, the assurance of my highest consideration. JOHN F. CRAMPTON.

HON. J. M. CLAYTON, &c., &c.

REWARDS OFFERED BY THE BRITISH GOVERNMENT.

Three thousand pounds, or a proportion thereof, according to the services rendered, offered by Lady Franklin to such of the whaling ships as shall be generously inclined to assist in the search for Sir John Franklin and his gallant companions.

With the view of inducing any whaling ships that shall resort to Davis' Strait and Baffins Bay to make special efforts in search of the expedition under the command of Sir John Franklin, I hereby offer the sum of three thousand pounds (£3,000) or a proportion thereof according to the services rendered, to

such ship or ships as, departing from the usual fishing grounds, shall discover, and if needed, afford effectual relief to the above expedition or any portion of it.

It is proposed that the amount of reward, according to the efforts made and services performed, shall be determined by the following gentlemen, who have kindly consented to act as referees, viz: Rear-Admiral Sir Francis Beaufort, K. C. B.; Captain Sir W. Edward Pany, R. N.; Thomas Word, Esq., (Hull).

In regard to the distribution of the sum awarded among owners, captains, officers and seamen, the amount to each to be adjusted in the same proportions as if similar value of produce had been obtained. In the event of more than one ship making special efforts to give succor to the expedition, each ship is to receive its proportion of the reward agreeably to the decision of the referees.

The attention of whalers disposed to aid in this service is particularly directed to the Gulf of Boothia, within Regents Inlet, or to any of the inlets or channels leading out of Barrow's Strait, or the sea beyond, either northward or southward, as also to any sounds or inlets in the north and western sides of Baffin's Bay above the seventy-fifth degree of latitude.

Should it be clearly proved and ascertained that any whaler has made extraordinary efforts or special researches in quarters remote from the ordinary fishing grounds, for the purpose designated, though no success may have attended their endeavors, the case of such whaler, with a view to reward, will be taken into favorable consideration by the referees.

For the greater satisfaction of parties claiming reward, the owners and captains shall be authorized, if they desire, to nominate one additional referee, who shall act and vote in all respects as the standing referees in the special case for which they may be nominated. The referees, being then increased to four, will, according to the usual order of business, choose for themselves a fifth as umpire.

Twenty thousand pounds sterling ($100,000) reward to be given by her Britannic Majesty's government to such private ships or to any exploration parti s of any country as may in the judgment of the Board of Admiralty, have rendered efficient assistance to Sir John Franklin, his ships or their crews, and may have contributed directly to extricate them from the ice.

The attention of whalers or any other ships or parties disposed to aid in this this service is particularly directed to Smith's Sound and Jones' Sound, in Baffin's Bay, to Regent's Inlet and the Gulf of Boothia as well as to any of the inlets or channels leading out of Barrow's Strait, particularly to Wellington Strait or the sea beyond, either northward or southward. Vessels entering through Behring's Strait would necessarily direct their search north and south of Melville Island.

H. G. Ward. Sec. to the Admiralty.

London, March 23, 1849.

MR. BANCROFT TO MR. CLAYTON.

(*Extract.*)

United States Legation, London, June 15, 1849.

Sir :— * * * * The newspapers having announced that it is the President's intention to fit out two ships to go in search of Sir John Frank-

lin, the Royal Society have passed a vote on the subject, which the Earl of Rosse, president of the Royal Society, has communicated to me by a letter, a copy of which is inclosed. Not having any official knowledge of the President's intention, I have taken care, when appealed to, to say that I know nothing on the subject beyond what was before the world. You will observe, also, that the subject has engaged the attention of the House of Commons. I was present and heard Sir Robert Inglis, Lord Palmerston and Mr. D'Israeli speak of it in the handsomest manner. * * * * * *

I am, respectfully,

HON. J. M. CLAYTON, GEORGE BANCROFT.
Sec. of State, Washington, D. C.

THE EARL OF ROSSE TO MR. CLAYTON.

13 CONNAUGHT PLACE, June 9, 1849.

MY DEAR SIR:—I have the honor to inform you that at the annual meeting of the Royal Society held the 7th inst., a communication was read from Admiral Sir F. Beaufort in which he apprized the society that the American Government had nobly undertaken to send an expedition in search of Sir John Franklin, upon which a vote of thanks was moved by Sir Charles Lemon, seconded by Lord Northampton, and carried with the utmost enthusiasm, expressive of the gratitude of the Royal Society to the American Government and of their deep sense of the kind and brotherly feeling which had prompted so liberal an act of humanity.

Allow me to assure you that it is peculiarly gratifying to me to have the honor of being the humble instrument in conveying to you the thanks of the Royal Society on this occasion; and permit me to express a hope that this most generous act of the United States may, if possible, draw closer the bonds of friendship between the two kindred nations. That the United States may continue to progress with the same extraordinary rapidity in the arts of peace and civilization, and to hold the same high place in the science and literature of the world is, I am sure, the anxious desire of the Royal Society.

I have the honor to be, sir, very truly yours,

ROSSE.

His Excellency, George Bancroft, Esq.

MR. SMYTH TO MR. BANCROFT.

3 CHEYNE WALK, CHELSEA, June 20, 1849.

DEAR SIR:—Having notified to a general meeting of the Royal Geographical Society of London, holden on Monday the 11th inst., that the government of the United States, with noble feeling and generous liberality, ordered an expedition under the command of a very distinguished officer to assist in the search, in the Arctic regions, for Capt. Sir John Franklin, (late a vice-president of the said society) and his brave companions, it was resolved unanimously to transmit an expression of the society's gratitude to the American Government and their full sense of the benevolent impulse which prompted so admirable an act of humanity.

On so deeply interesting an occasion I beg to be allowed to assure you of the gratification I feel on being made the instrument of this expression, and

Believe me very sincerely your faithful servant,

W. H. Smyth, Pres. Royal Geographical Society.

His Excellency, Hon. George Bancroft.

LADY FRANKLIN TO THE PRESIDENT.

Spring Gardens, London, Dec. 11, 1849.

Sir:—I had the honor of addressing myself to you in the month of April last, in behalf of my husband, Sir John Franklin, his officers and crews, who were sent by her Majesty's government, in the spring of 1845, and who have never since been heard of.

Their mysterious fate has excited, I believe, the deepest interest throughout the civilized world, but nowhere more so, not even in England itself, than in the United States of Amcrica. It was under a deep conviction of this fact, and with the humble hope that an appeal to those generous sentiments would never be made altogether in vain, that I ventured to lay before you the necessities of that critical period, and to ask you to take up the cause of humanity which I pleaded, and generously make it your own.

How nobly you, sir, and the American people, responded to that appeal, how kindly and courteously that response was conveyed to me, is known wherever our common language is spoken or understood, and though difficulties which were mainly owing to the advanced state of the season, presented themselves after your official announcement had been made known to our government, and prevented the immediate execution of your intentions, yet the generous pledge you had given was not altogether withdrawn, and hope still remained to me that, should the necessity for renewed measures continue to exist, I might look again across the waters for the needed succor.

A period has now, alas! arrived, when our dearest hopes as to the safe return of the discovery ships this autumn are finally crushed by the unexpected though forced return of Sir James Ross, without any tidings of them, and also by the close of the Arctic season. And not only have no tidings been brought of their safety or of their fate, but even the very traces of their course have yet to be discovered; for such was the concurrence of unfortunate and unusual circumstances attending the efforts of the brave and able officer alluded to, that he was not able to reach those points where indications of the course of the discovery ships would most probably be found. And thus, at the close of a second season since the departure of the recent expedition of search, we remain in nearly the same state of ignorance respecting the missing expedition as at the moment of its starting from ou shores. And in the meantime our brave countrymen, whether clinging still to their ships or dispersed in various directions, have entered upon a fifth winte in those dark and dreary solitudes, with exhausted means, while yet their exp cted succor comes not.

It is in the time, then, of their greatest peril, in the day of their extremest need, that I venture, encouraged by your former kindness, to look to you again for some active efforts which may come in aid of those of my own country, and add to the means of search. Her Majesty's ministers have already resolved on sending an expedition to Behring's Strait, and doubtless have other necessary measures in contemplation, supported as they are, in every means that can be desired for this humane purpose, by the sympathies of the nation and by the generous solicitude which our Queen is known to feel in the fate of her brave people imperiled in their country's service. But, whatever be the measures contemplated by the Admiralty, they cannot be such as will leave no room or necessity for more, since it is only by the multiplication of means, and those vigorous and instant ones, that we can hope, at this last stage, and in this last hour, perhaps, of the lost navigators' existence, to snatch them from a dreary grave. And surely, till the shores and seas of those frozen regions have been swept in all directions, or until some memorial be found to attest their fate, neither England, who sent them out, nor even America, on whose shores they have been launched in a cause which has interested the world for centuries, will deem the question at rest.

May it please God so to move the hearts and wills of a great and kindred people, and of their chosen chief magistrate, that they may join heart and hand in the generous enterprise. The respect and admiration of the world, which watches with growing interest every movement of your great republic, will follow the chivalric and humane endeavor, and the blessings of those who were ready to perish shall come upon you.

I have the honor to be, sir with great respect,

Your grateful and obedient servant,

JANE FRANKLIN.

His Excellency, the President of the United States.

LADY FRANKLIN TO MR. CLAYTON.

SPRING GARDENS, LONDON, Dec. 12, 1849.

SIR:—I beg to transmit, through you, to the President of the United States, the accompanying letter, trusting to that same kindness on his part of which you have already been the feeling and eloquent exponent, that it will be received with an indulgence similar to that which I met with before.

Sir John Richardson informs me that the interest felt in the United States for the unfortunate missing expedition under my husband's command is as lively and deep as ever, and in this feeling, and in the benevolent disposition of the President, I place my humble confidence.

I have the honor to be, sir, your obliged and obedient servant,

JANE FRANKLIN.

The expressed sympathy of the government as shown in the above correspondence, met with a hearty support from the press of the country, but from various causes failed to yield practical results and it became evident that if the United States was to share in the search for the lost navigator something more decisive and tangible must be done. In this emergency Mr. Grinnell, of New York, tendered the use of the necessary vessels, in a memorial which was presented in the Senate April 5, 1850, by Henry Clay, as shown by the following extract from the Congressional Globe of that date:

* * * * * * * * *

"Mr. Clay presented the memorial of Mr. Henry Grinnell, of New York, stating that he was fitting out two or three vessels in the port of New York to send out in search of Sir John Franklin, and requesting the services of certain seamen of the United States under command of subordinate officers of the Navy to give the vessels something of a naval and military discipline, as essential to the success of the enterprise." * * * * *

Mr. Clay referred in warm terms to the high standing and public spirit of Mr. Grinnell, and on his motion the memorial was referred to the Committee on Naval Affairs.

In the course of his remarks Mr. Clay said that he feared Sir John and his companions would not be found alive, but that the attempt to find them would be gratifying to the whole world, and many useful discoveries might be made that would add to the knowledge of the world, and amply repay any expenditure that might be incurred by the United States.

Mr. Clay also presented a petition signed by a great many merchants and citizens of Philadelphia, recommending to Congress the passage of some measure favoring Mr. Grinnell's enterprise.

In the House of Representatives. April 25, 1850, Mr. Stanton, of Tennessee, from Committee on Naval Affairs, reported a joint resolution to authorize the President of the United States to accept and attach to the Navy the two vessels offered by Mr. Henry Grinnell, of New York, to be sent to the Arctic seas in search of Sir John Franklin and his companions, and said it was important that early action be taken.

Objection was made by Mr. Bayly, of Virginia, who referred to it as a "wild goose chase," and moved to lay the resolution on the table, which was defeated by a vote of yeas, 70, nays, 99.

Fears were entertained by the opponents of the measure that Congress would be called upon at some future time to compensate Mr. Grinnell for the use of his vessels, and in reference to this Mr. Brooks, of New York, said: * * "The object of the expedition was not to obtain money from the government, neither *now* nor hereafter, as had been insinuated.

The projector of the expedition, impelled by the highest influences that could nerve a man, proposed to fit out two vessels costing some $30,000, at his own expense, asking of the government nothing save that it extend over them the protection of its flag and give them the discipline of its Navy. * * * * It was felt and known that a private vessel with sailors enlisted only under our mercantile laws as for the mercantile marine, could not have that discipline on board, that salutary and efficient government which might be necessary in high northern latitudes under the most trying circumstances in which human beings might be placed. To prevent mutiny, to enforce law, to compel if necessary self-sacrifice—the discipline and government of the Navy were wanted, and it was unwise if not unsafe to send two vessels to the Arctic seas for the purpose contemplated with only the discipline of the mercantile marine to govern them. * * * Can you look other nations in the face if you decline to coöperate in this enterprise, and let them have all the honor of exploring even your own North American Continent? * * * With reference to the remark of Mr. Bayly that it was a "wild goose chase," Mr. Brooks said: "I am afraid that all mankind, and especially that portion whom I represent, will not acquiesce in the judgment of the gentleman from Virginia, and will be as earnest as ever to solve the problem. This is an expedition which humanity invokes, which science calls for, which continental pride demands from you, and you alone of all other nations."

After some desultory remarks from various members the subject went over until next day, April 26, when Mr. Stanton advocated immediate action, and was opposed by Mr. Bayly, Mr. Savage, and others, as visionary.

During the discussion, which consumed most of the day's session, considerable sectional feeling was developed, which led Mr. Cable, of Ohio, to offer the following amendment to the joint resolution, which was received with much merriment:

Provided, That neither slavery nor involuntary servitude, except for crime, shall exist in any country or countries which may be discovered by said expedition about the North Pole.

The following extracts from Mr. Bayly's remarks are of interest as showing the feeling at that time against uniting the government with any private enterprise: " * * * * If it is proper for us to engage in it at all, we ought to do it on our own account and in a manner becoming a great naval and commercial nation. I do not think it becoming, especially after the lofty ground our Executive has taken, that we should satisfy ourselves with acting a secondary part in rather a small private enterprise. * * I repeat, sir, and I desire to do it emphatically, if we are to engage in this enterprise let us do it on our own account, in a manner befitting us as a nation; let us send out a national vessel under instructions from our government and upon our national responsibility. * * If we have no vessels that are fit for the service, let us purchase such as are, or have nothing to do with this expedition. Do

not let us connect ourselves with it just so far as to make us responsible for it without any control over it."

Mr. E. D. Baker, of Illinois, supported the resolution in some eloquent remarks, in the course of which he said: "It is this generous love of glory that I admire; it was this which prompted the 'World-seeking Genoese' to the noblest enterprise of any age and kept him firm amid the terrified mariners and on an unknown and stormy sea. It is this which kindles high hearts to all great enterprises; and, sir, when this love of glory seeks its accomplishment in noble discovery, I not only admire but honor it, and I am honored in being allowed to aid it. But, sir, the whole American people have an interest in these expeditions. It is no longer true of England that she is 'mistress of the ocean;' we too hold our 'march upon the mountain wave,' our keels vex every sea; and whatever opens new channels of commerce, adds to our wealth and dominion. And yet I am disposed to place the support of this measure upon higher ground. It has been said that literature belongs to no age and no country. It may be repeated of discovery and invention, as the benefit is for all ages and all countries, for the world and for the whole family of man."

Several attempts to adjourn the House without action were voted down, and after considerable fillibustering the main question was ordered and the joint resolution passed by a vote of 94 yeas to 45 nays.

The following is the text of the resolution as passed:

Resolved, That the President be and he is hereby authorized and directed to receive from Henry Grinnell, of the city of New York, the two vessels prepared by him for an expedition in search of Sir John Franklin and his companions; and to detail from the Navy such commissioned and warrant officers, and so many seamen as may be necessary for said expedition and who may be willing to engage therein. The said officers and men shall be furnished with suitable rations at the discretion of the President for a period not exceeding three years, and shall have the use of such necessary instruments as are now on hand and can be spared from the Navy, to be accounted for or returned by the officers who shall receive the same.

SEC. 2. Be it further *Resolved*, That the said vessels, officers and men shall be in all respects under the laws and regulations of the Navy of the United States until their return, when the said vessels shall be delivered to the said Henry Grinnell; *Provided*, That the United States shall not be liable to any claim for compensation in case of loss, damage or deterioration of the said vessels or either of them, from any cause or in any manner whatever, nor be liable to any demand for the use or risk of said vessels or either of them.

After the vote was announced, Mr. McLane, of Maryland, stated that he should favor the passage of a joint resolution refunding to Mr. Grinnell all the expenses he had incurred in fitting out the expedition.

This should have settled the matter in the House and did so far as action on the measure itself was concerned, but on two subsequent days—April 29 and May

1—warm discussions on points of order connected with its passage, form part of the record, showing the bitterness with which its opponents fought.

The joint resolution as it passed the House was reported in the Senate April 29, and a motion to refer it to the Committee on Naval Affairs, made by Mr. Bright, was withdrawn upon the statement of Mr. Miller, of New Jersey, that the subject had already been discussed in the Committee, and it had at its last meeting determined to report a similar resolution to the one now before them.

May 1st—On motion of Mr. Miller the Senate postponed all prior orders and took up the resolution. It was advocated by Messrs. Miller, Clay, Seward, Pearce, of Md., Yulee, of Fla., Dayton, of N. J., Butler, of S. C., and Houston, of Tex., and was opposed by King, of Ala., Foote, of Miss., and Davis, of Miss., and after a lengthy discussion passed by a vote of 28 yeas to 16 nays.

The following extracts show the line of argument followed by the speakers on both sides:

Mr. Clay said: "Although I accord in the expression of opinion urged against the union of a public and individual enterprise generally, yet in a case of this kind I should hope that would not be permitted to prevent the passage of this resolution. * * * It may turn out, too, that in carrying out this enterprise, other discoveries may be made which will benefit our country and the world."

Mr. King said: "If I could think it proper to mingle up the affairs of an individual with those of the government of the United States, I would unhesitatingly vote for this proposition. But I hold that the government of the United States ought not in any case to connect itself in this way with a private individual. I hold that you should not place the officers and seamen of the United States under the control of any private individual whatever. * * Is it not better that the United States should take the subject into its own hands and make a liberal appropriation? I would vote for the largest appropriation necessary to purchase suitable ships, and if this suggestion is approved I will move the recommitment of the resolution to the Committee that they may report a bill to carry out the suggestion—that the government of the United States may carry out the expedition at its own expense and that we may not mix ourselves as a government with the enterprise of any individual."

Mr. Miller said: "I prefer that the government should have the entire conrol of the enterprise, but this cannot now be done within the time required to produce the good results which are to be hoped from this expedition. * * * * If we refer the resolution back to the committee and they report a bill authorizing the government to build ships to carry on the expedition on its own account, it would be attended with very great delay, and in my opinion defeat the object we have in view."

Mr. Foote said: "It is proposed that inasmuch as the government of the

United States has become suddenly be-dwarfed in its faculties, and has lost all its efficiency for the execution of a noble undertaking that has once found favor in its eyes; and inasmuch as this government, whose naval power is now the object of admiration to all nations, is not able to supply ships suited to an interesting purpose of exploration; or, perchance, since pecuniary means for the execution of this grand scheme are not possessed by the government, a man of wealth is to be allowed to step in and monopolize the whole glory of the object; that he whose arms are stronger than the arms of the nation, he whose purse is more fully replenished with gold than that of the richest nation in the world, shall be allowed to fit out this expedition according to his own individual judgment, while this government shall become, not a dormant partner, but shall become an openly declared but yet a decidedly *subordinate* partner in the concern. * * * * The government cannot engage in this enterprise without a serious loss of dignity at least. * * * If anything is to be done let it be done with a due regard to the honor of the nation and with a full view of the responsibility connected with our acts."

Mr. Seward said: "When great objects and great enterprises which are feasible are hindered or defeated, it is not so much by want of agreement concerning the measures themselves as by diversity of opinion concerning the mode of carrying them into execution. * * * I accordingly agree with those honorable Senators who would have preferred the government should have moved for the attainment of this object as a government, and made it exclusively the act of the nation, * * * but the government has not moved and the time has arrived when a movement must be made, and I shall vote for the resolution."

The opposition dwelt strongly upon the failure of the administration to carry out its implied promise of aid in the Lady Franklin correspondence, and most of the debate turned upon this point, the Democrats attacking and the Whigs defending the administration in the usual partisan manner, but most of the Senators rose above party in view of the peculiar nature of the expedition. Of this class was Mr. Yulee, who said:

"I shall vote for the resolution because it may result in important advantages to our commercial interests. * * * We have many more officers in the Navy than the necessities of the service can require. The service will be actually benefited by the employment of some of the officers in this expedition—perilous and dangerous I agree, but yet honorable to them and advantageous to the government. These officers are receiving pay whether in service or not. The *personnel* of the Navy, so far as the seamen are concerned, is limited by act of Congress to 7,500 men, and no more can be employed. The whole amount of this matter then will be that thirty of these men will be employed in this instead of some other service and receive only the remuneration which they would receive elsewhere in other situations. But more than all this. It is not at all unlikely that this expedition may reach beyond the icy barrier, into

open seas, which may open to our varied interests a very large field from which increased benefits may be derived."

Mr. Butler said: "It will indeed be a great triumph to American enterprise if we could make the discovery about which so much has been said, a very great triumph. I know that national reputation is national property of the highest value; and if we can acquire reputation by making the discovery, I shall rejoice at it. The chairman of the Committee on Naval Affairs has told us that these officers are willing to embark in this hazardous enterprise, and that the men will also embark voluntarily; and he also tells us that he is taking men who are doing nothing and putting them into employment, such as may redound to the honor of the country."

Mr. Houston said: "I shall vote for the resolution because it will afford American officers and American seamen an opportunity of distinguishing themselves and acquiring a reputation and character for our naval force."

The joint resolution was approved by the President May 2, and so promptly was Mr. Grinnell seconded by the Government now that proper authority had been obtained, that the expedition sailed from New York on the twenty-second of the same month.

It consisted of two small sail vessels—the "Advance," 144 tons, and the "Rescue," 91 tons—with the following officers and crew, detailed from the U. S. Navy:

Advance.—Officers: Lieutenant Commanding, Edwin J. De Haven, Commanding the Expedition; Passed Midshipman, Wm. H. Murdaugh, Acting Master and First Officer; Midshipman, William I. Lovell, Second Officer; Elisha Kent Kane, M. D., Passed Assistant Surgeon. Crew: Wm. Morton, Henry De Roque, John Blinn, Gibson Caruthers, Thomas Dunning, William West, Charles Berry, Louis Costa, William Holmes, Edward Wilson, William Benson, Edward C. Delano, James Smith.

Rescue.—Officers: Acting Master, Samuel P. Griffin, Commanding the "Rescue"; Passed Midshipman, Robert P. Carter, Acting Master and First Officer; Boatswain, Henry Brooks, Second Officer; Benjamin Vreeland, M. D., Assistant Surgeon. Crew: William J. Kurner, Auguste Canot, John Williams, Robert Bruce, William Lincoln, Smith Benjamin, Rufus C. Baggs, David Davis, James Johnson, James Stewart, Alexander Daly, H. J. White.—Total, 33.

The expedition reached New York on its return, Sept. 30, 1851, having been absent a little more than sixteen months, having aided in the discovery of authentic traces of Sir John Franklin's party and of the land named after the projector of the expedition, "Grinnell Land."

The detailed narrative of the expedition, by Dr. Kane, and published by Harper Bros. in 1853, is one of more than common interest, and should be read by those who wish to obtain a clear idea of Arctic life and enterprise.

ZOÖLOGY.

SILK CULTURE—A NEW SOURCE OF WEALTH TO THE UNITED STATES.

BY PROF. C. V. RILEY, WASHINGTON, D. C.

(*Abstract.*)

On account of the length of the paper, and in order to economize the time of the Association, Prof. Riley presented the argument without the details.

The paper is largely statistical, giving tables of exports and imports of raw and manufactured silks for the last half century, and bringing out clearly the steady growth of the silk manufacturing industry of the country, especially during the last decade, under the protective import duties on manufactured goods. The author starts out with the axiom that the establishment of any such wealth-producing industry as that of silk culture and manufacture as an integral part of our productive resources, is well deserving the attention of the people and of legislators. Just as the American Philosophical Society, little more than a century since, gave great impetus to, and fairly established the silk industry in Pennsylvania—established it so firmly that, had it not been for the Revolution, it would undoubtedly have continued to grow from that day on, so there is no reason why the American Association for the Advancement of Science should not be partly instrumental in re-establishing that industry on a broader and more permanent basis. The author rapidly sketches the history of silk culture the world over, and especially in the United States, showing how from 1740 to 1790 hundreds of silk-growers in the Southern, Middle and New England States, and especially about Mansfield, Conn., were successful, and how the industry has flourished under the stimulus, at times, of State aid. He traces the causes of failure in the past, and the point is strongly brought out that they were all transient, not permanent ones.

Speaking of silk culture, Peter Delabogie, in an address published in the very first volume of the Agricultural Transactions of the State of New York, (1801,) said:

"GENTLEMEN: You have in your hands all the means requisite for success and for enriching yourselves with the culture of silk. It remains with you to compare and judge our many attempts in it, and discover wherein they have been defective."

Prof. Riley points out wherein the first attempts have been defective, and have consequently failed. Every writer who has given the subject thorough consideration has been of the opinion that there are no absolute obstacles in the way of silk culture in this country.

Mr. A. T. Lillie, in an admirable review of the silk industry in the United States, from 1766 to 1874, drawn up largely from personal reminiscences, says: "The production of raw silk in this country, which, in 1828, amounted in Mansfield alone, to three thousand two hundred pounds, and which ceased entirely in 1844, has since been revived in California, meeting there with modified success. There is no good reason why it should not be again extended throughout the United States. Since the introduction of the mulberry seed by Dr. Aspinwall, in 1766, the history of this culture has been pregnant with encouragement, and only a fortuitous conjunction of misfortunes checked it."

Speaking of the attempts of M. Provost in California, which is conceded to be, by climate, eminently adapted to the growth of the mulberry, and the rearing of the worms, Mr. Riley attributes much of the want of permanent success which followed the efforts made at San Bernardino to the extravagant statements and excessive enthusiasm, verging on fanaticism, which characterized all of M. Provost's writings and utterances. Had he been as prone to report failure as he was to magnify success, there would not have been a re-active depression, which was as unnatural as was the over-enthusiasm. M. Provost's little work, "The California Silk Grower's Manual," was better calculated to induce another multicaulis fever than to healthily stimulate silk industry. Its exaggerated pictures and immoderate statements annul what little value it did possess, and earn for its author the name of *blagueur*, which has been applied to him in France.

Speaking of the effort of M. E. V. Boissiere, at Silkville, in Franklin county, Kansas, Mr. Riley expresses the highest appreciation of the intelligent attempts of the founder of that silk colony. The industry has, however, lagged, for the simple reason that it has been found less profitable than stock-raising and other general farming operations. M. Crozier, who has had charge of the silk establishment lately, has also found that the sale of eggs and the sale of mulberry cuttings are more profitable than the reeling and manufacture of the silk, and there is great danger that, from self-interest, greater harm than good will eventually come from this Kansas attempt. M. Crozier is now making every effort to encourage the purchase of his mulberry trees, an attempt which must be as injurious as it is premature, because it is stimulating an unnatural demand for the trees, in the face of the fact—shown by his own experience—that there is no profit yet to be derived from the production of the cocoons.

Very much the same may be said of other efforts that have been highly applauded without sufficient cause, and of plans prematurely and glowingly reported. As an instance, Mr. Riley mentions the accounts that have recently been published of the success attending the efforts of Mr. S. Lowery, of Huntsville, Alabama, who is reported to have successfully raised and spun and utilized the silk, and who is said to contemplate establishing an industrial academy for silk culture. Investigation shows that the few cocoons (reared by one of Mr. Lowery's daughters) are of an inferior Syrian race, having no commercial value; that the worms were fed on lettuce, and that the silk which was carded and spun is simply interesting as a curiosity, but not as an article of commerce.

The most valuable portion of the paper is that which points out the present prospects of silk culture and the way in which it may be established. In his report for 1877 to the President of the United States, the Commissioner of Agriculture gives tabular estimates of the value of many different products which we now import from foreign countries, and which may be produced at home, and this shows that over $236,000,000, not including additional expense for freight and commissions, are paid annually for imports, all of which could and should be saved to the people. The item of silk alone foots up to over $23,000,000.

In his commendable efforts to increase the productive capacity of the country by the encouragement of neglected industries, silk culture has not been overlooked by Commissioner Le Duc, and Prof. Riley expresses his gratification that his connection with the Department will enable him, with the Commissioner's co-operation, to do something for the permanent establishment of this industry, which he has followed with interest since the publication of his article on silk culture, in his Fourth Missouri Entomological Report (1871). Mr. Riley shows that the time is rife for systematic, intelligent effort in the line of silk-raising. The old argument that we can not compete with the cheap labor of Europe and Asia, no longer has the force it had in years gone by. With a large tramp element that is proving disastrous and annoying; with a large portion of the population in the more crowded Eastern cities out of employment; with any number of females and young people most anxious to earn something for a livelihood; with the people of the South looking for new avenues of industry—the cheap labor argument can no longer be successfully made against silk culture. The cheap labor of foreign countries is just as available for cotton and other industries as for silk, and the same objection has at one time or other been urged against most of our more important industries. Our people are neither lacking in industry, ingenuity or energy, and will more than make up in these respects for the more ignorant, though cheaper labor, of other countries.

But it is not a question, Prof. Riley argues, of whether we can compete with foreigners, either in living as cheaply or producing as cheaply. It is a question of adding to our own productive resources. There are hundreds of thousands of families in the United States to-day who would be most willing to add a few dollars to their annual income by giving light and easy employment for a few months each year to the more aged, to the young, and especially to the ladies of the family, who often have no other means of profitably employing their time.

This holds especially true of the people of the Southern States, most of which are pre-eminently adapted to silk culture. The girls of the farm, who devote a little time each year to the raising of cocoons, may not earn as much as their brothers in the field, but they may earn something, and that something represents an increase of income, because it provides labor to those members of society who at present too often have none that is remunerative. Further, the raising of a few pounds of cocoons each year does not, and need not, materially interfere with the household and other duties that now engage their time, and it is by each household raising a few pounds of cocoons that silk culture must in the end be

carried on in this, as it has always been in other countries. Large rearing establishments seldom pay.

Experiments that have been made in the past, and a series the author himself had been carrying on for the last ten years, abundantly establish the fact that the climate of the larger portion of the United States is admirably adapted to this culture. This is not only proved by the healthfulness of the worms, when intelligently fed and cared for, but by the fact that we have a larger number of native silk producing insects than any country of the same extent, and by the further fact as proved by experience, that silk raised here is of a superior quality.

Now, experience shows that silk culture in the past has failed largely because of the want of a market, and Prof. Riley maintains that the first thing requisite is not the dissemination of mulberry trees or of silk-worm eggs, but the establishment of filatures or reeling factories. All attempts to stimulate the industry unduly are hurtful. It must grow, as all other industries have, and when once firmly established, on however small a scale, there can be no doubt that it will grow as steadily as all other industries have grown when once established in this country. The difficulties met with in the past have not been greater than they were in France and other countries, which persevered until failure after failure was overcome.

The great question is, how shall we encourage the production of silk and the reeling thereof? There is at present no market in this country for cocoons, except for those which are pierced, and which, being carded and spun, bring a very low price. Nor will there be a market for them until some one shall engage in the business of reeling. Yet it would not be prudent for any business man to engage in reeling until he had some assurance of getting a supply of cocoons. Now, how to break out of this close circuit is the problem. Just as the manufacturing industry has been stimulated by the encouragement given it by the National Congress, silk culture should be in the same manner stimulated.

There ought to be no real antagonism between the manufacturer and the producer, and our manufacturers would certainly very gladly purchase home-raised silk in preference to that raised abroad, more particularly as they find it very difficult to prevent fraud and deception on the part of their Asiatic dealers. Yet, a duty on raw silk that would encourage or stimulate the growth thereof in this country would naturally meet with the opposition of manufacturers, and here lies the whole difficulty. Yet it is not an insuperable one. Protection of a productive industry in its infancy adds to the general wealth; protection of the manufacturing industry, while desirable as a fostering agency, becomes injurious to the masses by benefiting the few and encouraging monopoly, unless wisely gauged and enacted There is always great danger of unwise legislation in the interest of manufactures, brought about by influences which associated capital can always wield.

With improved machinery, with superior labor, and the greater profits that naturally flow from them, our silk manufacturers have prospered, and their late rapid increase during a period of general depression in other branches of indus-

try is the best evidence of the fact. They are in a position to bear a small import duty on raw silk. If Congress will impose such a duty, and in addition give the Department of Agriculture the means to erect proper reeling machinery, and to introduce properly trained reelers, so as to form a nucleus for the reeling branch of the industry, this is all, in Prof. Riley's opinion, just now needed from the National Legislature. The dissemination of proper information and of silk-worm eggs may be left to the Department.

Our attempt should be to encourage the culture of silk, and the reeling of silk, without, if possible, affecting or injuring the throwing and twisting business, which is perhaps not firmly enough established to be able to continue without some protection. To cripple or destroy or impair this industry would, of course, remove the market of the silk-grower, and there is no absolute necessity for any present change in the present tariff on manufactured silks.

Prof. Riley believes further that each State should encourage not only the culture of silk, but offer a bounty of, say 50 cents or $1 per pound for the cocoons, and $1 or $1 50 per pound for reeled silks.

The part of the paper that is, perhaps, the most interesting from a scientific point is that relating to the production of silk from the osage orange.

Mr. Riley has been very much interested in this part of the inquiry for many years, and has raised consecutively for the last eight years a race or breed of worms—a cross between one of the best Japanese and one of the best French races—with great success. He found that the worms, became if anything, more and more healthful and hardy upon this plant. Silk from osage orange reared worms, when fed intelligently, was in both quality and quantity equal to that from mulberry fed worms. This important fact is not admitted by those who have mulberry trees for sale, but Prof. Riley has good reason, based on experience and experiment, for the statement. This he considers a very strong point in favor of the United States, as, in case the mulberry trees should at times be cut off, as they were at the close of the *multicaulis* fever of 1839 and 1840, by mildew and disease, American silk-growers, could, nevertheless, continue their calling by employing the osage orange, which, throughout that portion of the country best adapted to silk culture, thrives and is never subject to any such injury. Moreover, in order to commence the raising of silk the average farmer will not have to wait for the growth of the mulberry trees, or lay out any capital therefor.

There is an increasing interest manifested throughout the country on this subject. . Inquiries are constantly being received at the Department of Agriculture as to how to attend to the worms, and on all possible subjects connected with silk culture, and it is the intention of the Department to send out or to publish in due time a comprehensive manual of instructions, and which, by widely disseminating the desired information on the subject, will help to establish the industry.

THE PHILOSOPHY OF THE MOVEMENTS OF THE ROCKY MOUNTAIN LOCUST.

BY PROF. C. V. RILEY, WASHINGTON, D. C.

(*Abstract.*)

No paper so far read before the Association contained in so short a space the results of such extensive observations and investigations. In reality, it gives a *resume* of some of the more interesting scientific results of the investigations of the United States Entomological Commission. The author shows that prior to the year 1876, very little that was accurate and reliable was known of the destructive locust that at times proved so disastrous to the agriculture of the trans-Mississippi country, while still less was known of its movements. Had any one been asked even eighteen months ago, whence come the ravenous hordes that sweep over the fertile country between the Rocky Mountains and the Mississippi, or whither they go, he could have given but a hypothetical answer. Mr. Riley shows that the situation is now materially altered, and that we are in possession of much absolute knowledge, both as to the habits, natural history and movements of this destructive insect.

The paper treats mainly of the principles which underlie these movements. The author premises that any rule or law we may formulate in biological science will admit of exceptions, and can never possess the same fixed and absolute character that belongs to rules in the exact sciences.

In order to treat intelligently of the locust problem in the West, the United States Entomological Commission found it necessary to divide the territory affected by the destructive species (*Caloptenus spretus*) into three principal regions.

First, the Permanent Region, or native breeding grounds of the species, which comprises all the vast region of the Northwest, between the latitude 37° and 52°, and reaching from the mountains to about the 103d meridian. This forms altogether the most extensive breeding ground, and comprises an area north of the boundary line nearly equal in extent to that south of the same. West of the main range it is represented by more restricted areas. In all this vast region the climatic conditions and flora characteristics are similar. It is an extensive plateau, from 2,000 to 6,000 feet above the sea level. The summers are unusually dry and intense, the winters long and severe. The atmosphere is attenuated and the vegetation generally sparse; the ordinary plains covered with short but nutritious grasses, now giving way in moister sections and along water courses to a rank prairie growth; now to almost complete desert, where little but the sage bush and a few cacti will grow. In the main it is what naturalists call a sub-boreal region. The extent of this territory is not less than 300,000 square miles. But the insect does not breed uniformly over the whole. It propagates principally on the most moist plateaus; in the river valleys; in the sub-Alpine mountain parks, protected slopes, canyons and so on, wherever, in short, vegetation

is favored; the valleys of the South Saskatchewan, the Yellowstone and North Platte being the most extensive breeding areas.

The prevailing winds in this region, east of the mountains, are conspicuously from the northwest during the season when the insect is attaining maturity and full wing-power, and it is from this region that emanate the swarms that sweep the Lower Mississippi country. West of the main range and in portions of Montana and Wyoming, especially west of the Belt Range, there is no such uniformity in the course of flight, and local influences more materially affect it. The species is always to be found more or less numerously in this Permanent region.

The Sub-permanent region is a comparatively narrow area, bordering the Permanent region on the east, where the insect is perpetuated for several years, but from which in the end it disappears.

The Temporary region embraces the large extent of fertile country lying all around the other two regions. It is the country which the insect visits and devastates at irregular intervals, in which it can not permanently thrive and which it almost always vacates within a year. In this Temporary region the species becomes diseased and can not hold its own, and in the Mississippi Valley there is always a return migration of such insects as hatch within it, and do not perish from disease and enemies before getting wings, the direction being conspicuously toward the Permanent region. This return migration, first set forth by Prof. Riley in 1874, commences in April in Texas, and continues from more northern points till about the middle of July, and, as in the case of the invading movements from the Permanent region, which occur from the middle of July on through the autumn, it is aided by the prevailing winds which, during April, May and June, are pretty constantly toward the northwest. In speaking of the causes of migration, Prof. Riley shows that there is some truth in many of the different theories advanced in explanation of these migratory movements, and that we must not look to one, but to several causes that may, either singly or combinedly, produce the result. The predisposing cause he considers to be excessive multiplication, for the others are mostly secondary, or but consequences of this one. Among these he mentions: (1.) Hunger. (2.) The procreative instinct. (3.) Increase of and annoyance from natural enemies. (4.) Instinctive impulse. The paper shows clearly that all these minor causes act more or less effectively, according to circumstances.

Regarding the fourth, or instinctive impulse, which most naturalists are not inclined to allow in an insect, the author remarks, that, as already stated, the return movements are aided by the wind. That they are not, however, solely dependent on the wind, but largely instinctive, is proved by numerous observations, showing that the insects, in migrating, pursue a definite course, and move only when the wind favors that course. Numerous instances confirmative of this statement are recorded in the report of the Commission that has lately been published. The insects, in migrating, only move when the wind favors their course. This is particularly true of the return migration. Again, the fact that there is a well marked limit line to the eastward spread of the insect, coupled with the return mi-

gration, is not to the same extent susceptible of any other explanation. The preservation of the species—an instinctive desire to go to a more congenial soil and climate—is evidently the principal exciting cause to this return migration. Hunger can have no part in it, since the insects pass over great stretches of luxuriant vegetation, both wild and cultivated. In the Professor's words: "The more I study these movements, the more I feel that for their proper explanation we must allow a certain amount of instinctive guidance, akin to that possessed by migratory birds." In treating of the eastern limit of the spread of this pest, Prof. Riley brings out some very interesting facts. Nothing seems more natural at first blush than that an insect which is able to travel, in the course of a single summer, from the Northwest Territory to Galveston, or points further south, and from the Rocky Mountains to Central Iowa, should also be capable of extending to any part of the country. Yet the history of all past invasions shows that there is a well-defined limit beyond which the species has never reached to do harm, and beyond which there is every valid reason to believe that it never will, so long as the present configuration and climatic conditions of the continent obtain. Particularizing this eastern limit, it is shown to extend from a point starting from the southern end of Lake Winnipeg to some twenty miles east of St. Paul; thence south to Storey county, Iowa; thence westward, receding to Northwest Missouri; then bulging again to Pettis county, Missouri; and thence pretty direct through the extreme northwest corner of Arkansas to Galveston, Texas. There is here along this line a well-defined limit to the eastward spread of the destructive insect, more effectual than the highest mountain ranges in other parts of the country. This fact is established.

The explanation of the fact is another matter. Limit of the insect's power of flight was Walsh's explanation, but it is unsatisfactory, since *a priori*, there can be no such definite limit to the flight of an insect that can be carried by wind fourteen miles out at sea, and that can halt and rest at will.

The reasons are, according to Prof. Riley, physical, and principally atmospheric. In the prevailing direction of the winds during the seasons of flight, in the increasing humidity, consectaneous with decreasing altitude, and especially in the shade and moisture that accompany forest growth, he finds tangible reasons, and it is an interesting fact, first brought out by the Professor, that the separation of the timber from the plains and prairie regions—or more correctly speaking, the line that separates that vast region between the Mississippi and the mountains, in which the timber averages not more than six or seven out of every 100 acres, and that in which it averages twenty-five or thirty out of 100, forms in the main this limit line, both in the United States and in the Saskatchewan country.

Three important generalizations or rules for guidance are thus obtained for the solution of this locust problem. There is the invasion from the permanent to the temporary region, the return immigration from the latter to the former, and the eastern limit of extension. There is yet a fourth rule which also has some bearing on the movements of this locust. It is that in the temporary region whenever the young insects abound to such an extent as to keep the earth bare of veg-

etation in summer (implying thick and extensive egg-laying the previous year) there will be no eggs laid in such devastated region the same year. This means that a year of utter locust devastation, like that of 1875 in many parts of the west will be followed by one of perfect immunity from the pests. The explanation of this last rule is found in many interesting facts recorded in the Report of the Commission.

Speaking of the work of said commission, Prof. Riley remarked that during the past year it has been able to define or map the geographical range of the species, and to trace the source of the more injurious swarms. In short, what was mystery before is mystery no longer. "Aside from the large number of new facts of scientific interest as to the insect's habits, development, anatomy and enemies, we have learned how effectually to cope with the unfledged young, while we point the way to practically prevent the disastrous incursions from the permanent region." With these economic details the author did not wish to detain the Association, as they are given in the Report of the Commission.

When we recall the extent of the territory involved, embracing fully one-half of the superficial area of the United States, and remember how little that is definite is yet known of the sources, range and movements of the *Œdipoda migratoria*, which has since Biblical times so sorely devastated large portions of Europe and Asia, we may well feel some pride in our Government investigation. The importance of the work will best appear by the fact that the most careful estimates place the loss to the Western States and Territories since 1873 at $200,000,000, to say nothing of indirect loss and suffering on the part of frontier population, illy prepared to bear it. By virtue of the individual observations of the Commissioners, and of the special assistance and correspondence employed over the country affected, they were able confidently to state in advance to the farmers of the West that there would be no serious locust injury of a general character the present year, nor perhaps for some years to come; and they point to an emigration the past spring to the locust devastated regions of Texas, Kansas, Iowa, Nebraska and Minnesota, unprecedented in the history of our country, as part of the result of this encouraging announcement.

Speaking of the future work of the Commission, Prof. Riley said there is much yet to be done in more fully studying portions of the permanent regions yet unexplored, in giving practical application to the information obtained, and in securing the proper State co-operation and legislation to carry out the recommendations and suggestions already made. It is to this task that the Commissioners are now devoting themselves.

Before concluding, the author paid a well deserved compliment to Dr. F. V. Hayden, without whose knowledge of the needs of the West, his forethought and energy, the investigation, according to Prof. Riley, would scarcely have been ordered by Congress.

POETICAL VS. PRACTICAL ZOÖLOGY.

BY GEORGE L. AUSTIN.

The poetry of modern times enshrines many popular superstitions respecting members of the animal kingdom. It would not be desirable to remove them from its pages, for they supply illustrations of value and interest as to the intellectual condition of by-gone society, and are chapters essential to a complete history of knowledge. It is curious, however, to trace, when able to do so, such wild imaginations to their origin; and we purpose, in the present writing, to account for certain of these singular fallacies, fully believing that nearly all are referable to simply coincident circumstances.

We think that it has doubtless happened in many a sick-chamber, and immediately, too, before the dissolution of the patient, that the noise of the puny insect, vulgarly called the death-watch, has been heard. It was a very easy thing for the fancy of premonition to arise with this, which has so often disturbed the habitations of rural tranquillity, and from which they are not yet wholly free.

> "The solemn death-watch clicked the hour she died;"

but it was not the *voice* of the insect; the noise was owing to its beating on some hard substance with the shield or fore-part of the head. It is intended merely to summon a companion, and answers exactly to the call-note of a bird.

Everybody knows of the kingfisher, or, as the bird was called in the days of Aristotle, the halcyon. Dryden says:

> "Amid our arms as quiet you shall be
> As halcyons brooding on a winter sea."

And Browne:

> "Blow, but gently blow, faire winde,
> From the forsaken shore,
> And be as to the halcyon kinde,
> Till we are ferried o'er."

And the author of "The Storm" writes

> "All Nature seemed
> Fond of tranquillity; the glassy sea
> Scarce rippled; the halcyon slept upon the wave,
> The winds were all at rest."

The idea that the halcyon possessed the marvelous faculty of pacifying the wind and wave by its presence seems to have sprung solely from the well-known habits of the bird. It fishes only by sight, and takes only small prey. Hence all those circumstances require to be avoided which would interfere with distinct vision, in order to the success of its operations. It, therefore, frequents particular spots, and is out in certain states of the weather; brawling and turbulent streams are avoided; and the days when the atmosphere is the most transparent and still, the waters most calm and clear, are precisely those which the kingfisher loves, and in which he is most commonly seen.

Sir Walter Scott thus misrepresents the natural history of the field-fare, be-

longing to the thrush tribe, in the following picture, referring to Scottish ground:

> "Within a dreary glen,
> Where scattered lay the bones of men
> In some forgotten battle slain,
> And bleached by drifting snow and rain;
> The knot-grass fettered there the hand
> Which once could burst an iron band;
> Beneath the broad and ample bone,
> That bucklered heart to fear unknown,
> A feeble and a timorous guest—
> The field-fare—*framed her lowly nest.*"

Sir Walter was a keen sportsman; but he seems not to have known that the field-fare neither breeds in the British Isles, nor even builds on the ground in its native quarters. It is a bird of Norway, where it frames its nest in the firs and larches at the height of from ten to forty feet above ground. In the winter season it visits England and Scotland in great numbers.

Lord Byron likewise errs when he says:

> "Even as an eagle overlooks his prey,
> And, for a moment poised in middle air,
> Suspends the motion of his mighty wings,
> Then swoops with his unerring *beak.*"

The king of birds invariably seizes its prey with the talons, carries it off to the nest, or some other place of security, and there at leisure uses the beak for tearing it in pieces.

A poet may be pardoned for following the errors of the naturalist of his time but for a poet of the present day to adopt an old mistake of natural history, and to give to it circulation as an undoubted fact, it is altogether different and wholly unjustifiable. We should not blame the old dramatist for saying:

> "I will play the swan,
> And die in music."
> "He makes a swan-like end,
> Fading in music."

But surely Doane is culpable in the following iteration of a completely unfounded fancy:

> "'What is that, mother?
> 'The swan, my love.
> He is floating down, from his native grove,
> No loved one now, no nestling nigh;
> He is floating down by himself to die;
> Death darkens his eyes, and unplumes his wings,
> Yet the sweetest song is the last he sings."

Many if not most animals retire from the companionship of their kind to die in solitude. The swan may do this; but certainly there is no musical accompaniment in the case, for the bird is utterly incapable of it. The domesticated swan has no note but a hiss, and the tone of the wild or whistling swan is equally harsh and dissonant.

In the "Midsummer-Night's Dream," the fairies are said to light their tapers

"At the fiery glow-worm's *eyes*."

But it so happens that the luminosity proceeds, not from the eyes, but from the tail of the insect. Says Thomson:

"Along the crooked lane, on every hedge,
The glow-worm lights *his* gem."

But it happens, further, that the male glow-worm is very rarely seen, is much smaller than the female, and gives out no light. Thomson thus writes of another insect:

"Light fly his slumbers, if perchance *a flight*
Of *angry gadflies* fasten on the herd."

To make known the truth is to spoil the poetic beauty of this whole passage. But, though a small matter, to be sure, the error is sufficiently important to bear correction. The gadfly is not a social insect, and it pursues its way singly, not in a flight or swarm. Furthermore, it is not anger, but instinct, that induces him to "fasten on the herd."

It used to be supposed that gossamer, the web of the field-spider, was formed of dew evaporated by the sun's heat into threads; and it is to this that Quarles thus refers:

"And now autumnal dews were seen
To cobweb every green."

Milton goes astray in the following:

"Swarming next,
The *female* bee, that feeds her husband drone
Deliciously, and builds her waxen cells
With honey stored."

The working-bees, which form the mass of the population, are neuters; the drones are males; and of the queens, or females, there is usually but one in a hive.

The natives of New Guinea, and of the adjoining Papuan archipelago, in preparing and drying the skins of the gorgeous birds-of-paradise, are in the habit of removing the feet. In this state they are sold to the Malays, conveyed to India, and thence to European countries. This custom led Linnæus, erroneously to name one of the best known species "footless" (*Paradisea apoda*); and also misguided Southey in the following lines from his "Curse of Kehama:"

"The *footless* fowl of heaven, that never
Rest upon the earth, but on the wing forever,
Hovering o'er flowers, their fragrant food inhale,
Drink the descending dew upon its way,
And sleep aloft while floating on the gale."

A beautiful passage in the Book of Proverbs has been made the foundation for many wrong views of the habits of the ant, both in poetry and prose: "Go to the ant, thou sluggard; consider her ways, and be wise; which, having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest."

In these words, Solomon probably alluded to a species with which we are not familiar; but, waiving any dispute on this score, it will be observed that he makes no mention of any particular kind of food, and, if the idea of storing provision is suggested, imparts no hint of its being intended for winter use. A recent Oriental traveler speaks of a species of ant in India which hoards up in its cell the seeds of grass, and takes the precaution of bringing them to the surface to dry, when wetted by the heavy seasonal rains of the country.

Now, nothing is more common among men than to furnish their larders with more than is requisite for immediate wants, when abundance can be commanded, simply to save trouble. The general sentiment of the words of Solomon, then, relative to the ant, is that, in the appropriate natural seasons of summer and harvest, when food of all kinds is most readily obtained, the insect is industrious in profiting by favorable opportunities, having both present and prospective wants in view. But let us glance at the poetical representations—or, rather, misrepresentations—of the ant.

Dr. Watts yields his modicum of blunders:

> "They don't wear their time out in sleeping or play,
> But gather up *corn* in a sunshiny day,
> And for *winter* they lay up their stores;
> They manage their work in such regular forms,
> One would think they *foresaw* all the *frosts* and the storms,
> And so brought their food within-doors."

The poets, we imagine, would not thank us for meddling with their philosophy except *causa veritatis*. In the first place, the ant does not subsist on grain; but, being of a carnivorous habit, would prefer the carcass of a worm to all the wheat and corn in the world. In the second place, inasmuch as the greater part of the winter season is passed in a torpid state, the ant has no occasion to lay up a future store. The whole truth of the matter is this: Ants carry about their young in the state of *pupæ*, or as things wrapped up and swaddled, which both in size and shape have certainly some resemblance to grains of wheat. They are also seen occasionally gnawing at the end of one of these bandaged babies, for the purpose of liberating it from confinement. These operations, cursorily judged of according to the mere appearance, gave rise to the corn-bearing imagination for winter use, which Solomon's reference to summer and harvest seemed to sanction; and likewise to the idea of biting the grain to destroy the power of germination.

While writing of the ant, we are led to say a word or two with regard to the mole, which Aristotle, and a host of other writers since his day, pronounced blind:

> "Pray you, tread softly, that the *blind* mole may not
> Hear a footfall; we now are near his cell,"

are the words of Shakespeare. Dryden says:

> "Like a mole, busy and *blind*,
> Works all his folly up, and casts it onward
> To the world's open ear."

And Pope, also:

> "What modes of sight betwixt the wide extreme!
> The mole's dim curtain and the lynx's beam."

We will admit that there is a species of mole, indigenous to the south of Europe, which is totally blind; but the English species, to which Shakespeare, Dryden, and Pope, thus refer, has all the organs of vision perfect, and is not even dim-sighted. The eyes are very small, however. The sense of hearing is remarkably fine, and the sense of smelling is most exquisite.

And now comes the poor, harmless, and maligned toad, which has suffered great injustice at the hands of mankind. It was once believed that the head of an aged toad contained a stone or pearl possessing great virtues, and we all remember Shakespeare's lines:

> "Sweet are the uses of adversity;
> Which, like the toad, ugly and venomous,
> Wears yet a precious *jewel* in its head."

Unfortunately, there is no foundation in fact for this poetical simile.

Pennant, the naturalist, says of the toad that it is "the most deformed and hideous of all animals," which it is not; and the epithet of "venomous," which Milton applies to it in his picture of Satan, is singularly inaccurate. In reality, the toad is one of the most harmless and inoffensive creatures in existence. Let it alone, and it will hop out of your way; the fluid which exudes from some parts of its body is innocuous; and its bite produces nothing but a very slight inflammation. On the other hand, it is extremely useful in devouring grubs and vermin injurious to plants, and hence enjoys the special protection of the gardener.

It has frequently been said that the first example of the art of navigation was given to mankind by a mollusk common in the Mediterranean, the name of this mollusk being the nautilus, or argonaut. It is usually represented with six arms, extending over the sides of the shell, as if to act as oars; and two arms, which have broad disks upraised, as if to act as sails. Much beautiful poetry has been devoted to the celebration of this zoōlogical error:

> "Learn of the little nautilus to sail,
> Spread the thin oar, and catch the driving gale,"

says Pope. Montgomery, in his picture of the nautilus, writes:

> "The native pilot of this little *bark*
> Put out a *tier of oars* on either side,
> Spread to the wafting breeze a *twofold sail*,
> And mounted up and glided down the billow
> In happy freedom."

And Byron this:

> "The tender nautilus who *steers his prow*,
> The sea-born *sailor* of his shell *canoe*,
> The ocean Mab, the fairy of the sea,
> Seems far less fragile, and, alas! more free."

Unhappily for the poets, the nautilus never moves in the manner here described. It can creep along the bottom of the deep; it can rise to the surface

and float, moving backward through the water like other cuttle-fish. But the arms are not used as oars, and those which have the expanded membranous disk are never hoisted as sails. The sole purpose of these limbs is the secretion of the substance of the shell, both for its repair when injured and for the enlargement which the growth of the animal may require.

In the fossiliferous rocks the nautilus occurs among the earliest traces of the world's animal life. It continued through the long ages during which the family of its conqueror, the ammonite, was created, flourished, and became extinct. Mrs. Howitt has made this fact the subject of some graceful lines, which are not accurate, however, as to the formation of the stratified rocks, the habits of the mollusk, or the disappearance of its cousin-german:

"Thou didst laugh at sun and breeze,
In the new-created seas;
Thou wast with the reptile broods
In the old sea solitudes,
Sailing in the new-made light,
With the curled-up ammonite.
Thou surviv'dst the awful shock,
Which changed the ocean-bed to rock,
And changed its myriad living swarms
To the marble's veinèd forms.

"Thou wast there; thy little boat,
Airy voyager! kept afloat,
O'er the waters wild and dismal,
O'er the yawning gulfs abysmal;
Amid wreck and overturning,
Rock imbedding, heaving, burning,
'Mid the tumult and the stir:
Thou, most ancient mariner,
In that pearly boat of thine,
Sail'dst upon the troubled brine."

It remains to be said that the stratified rocks were formed by slow deposition, often in tranquil waters, and not by sudden catastrophes; that the ammonites did not perish from convulsive movements of land and sea; but that the family runs through all the formations from the silurian to the chalk, had its greatest development in the Oölitic period, and gradually died out.—*Appletons' Journal.*

WHEAT grains have a vitality which resists intense cold. A sample of the wheat left by the Polaris, in 1871, in 81 degrees and 16 minutes north latitude, and exposed to a temperature varying from that of summer to that of winter in that position for five years, was sown last year by Dr. Schanburgh, of the Botanic Gardens and Government Plantations, South Australia, and out of three hundred grains sixty germinated and produced plants, three and four feet high, with ears containing thirty grains each.

CORRESPONDENCE.

SCIENCE LETTER.

PARIS, FRANCE, August 30, 1878.

Perhaps Parisians are more occupied at the present time with the subject of hydrophobia than with their Exhibition. The average daily number of mad dogs executed, wherever found, is ten, and the proclamation on the part of the authorities to deal summarily with wandering dogs or cats, bitten by enraged dogs, is Draconian in its clauses. Some people blame the sun for the mischief; others attribute the cause to muzzling the animals. All is confusion respecting dog madness and hydrophobia. There would be no hydrophobia if there were no mad dogs; and none of the latter if they were not bitten by an enraged animal. Though inseparably related, hydrophobia and dog madness are not identical. It is indisputable that canine madness produces madness; the same cannot be so clearly alleged respecting hydrophobia, and the errors respecting the latter malady arise from its not having been methodically studied by doctors, many of whom have never had, happily, a case to deal with. It is curious that hydrophobia patients even share the errors current respecting this disease, concluding they are dangerous and begging their friends to keep out of their reach. These delusions explain in part the cruel remedies, &c., employed in the country districts for hydrophobia patients. The symptoms of the disease are perfectly defined, and are the same with the intelligent individual, the child, and the idiot.

The period of incubation of the virus varies, and this is not the least painful element in the event of being bitten by a dog; sometimes the disease will not manifest itself for six weeks or three months; the symptoms have appeared in eighteen days, and have only declared themselves in a very few and abnormal instances in five and seven years, owing it is supposed, to the virus having failed to enter earlier into the circulation. The symptoms of hydrophobia are, extreme nervous irritibility; terror; spasmodic contraction of the muscles of the throat excited by external influences, as the sight or noise of water. When the sufferer attempts to swallow a portion and succeeds, he not the less involuntarily turns his head aside; he experiences the sensation of being strangled, not only by the sound of falling water, but by passing a looking-glass before the eyes, or by the movement of an insect on the skin. Delirium follows this irritability; hallucinations succeed, mucus accumulates in the throat and mouth, and the patient in endeavoring to remove it, makes a noise, that the ordinary observer concludes resembles the barking of a dog; the feet are paralysed, and in endeavoring to walk firmly the patient falls, and hence the popular conclusion of crawling like a dog. Retchings ensue, the pulse becomes quick and weak, and death ensues

within twenty-four hours after the first symptoms. The agony can extend to even seven days. Frequently extreme tranquillity precedes death, the patient eats, drinks and talks rationally, but this deception is of short duration.

The difference between tetanus and hydrophobia is marked; in the former, the spasm is excited by the slightest touch; it is rigid, and weakens gradually away; there is neither thirst, retchings, nor foam at the mouth. In the case of hydrophobia the spasm is sudden and frequent—a convulsion. The symptoms of madness in the dog are well known, owing to a larger field of observation. The principal is a total change in the habits of the animal, which becomes somber and restless, incessantly licking the part bitten; if at the ear, he rubs the old wound; if at the foot, he gnaws it to the very bone; his appetite is eccentric; he devours morsels of thread, cord, silk, straw, &c.; is quarrelsome; if chained up, he will gnaw his wooden box, and will attack all the dogs he meets; the second day foam appears at the mouth, burning thirst ensues, which causes the animal to employ his paws against his throat to expel, as it were, some obstacle; in these efforts the animal trembles, for the legs are paralysed, also the muscles of the lower jaw, since the latter hangs and consequently the mouth remains open; the tongue is free. The dog wiil now begin to stare at some imaginary object, and to follow some invisible route; there is a strange hoarseness in the bark; the respiration is oppressive. On the fourth or fifth day the dog dies in convulsions or sometimes calmly.

It is a popular error to suppose that the afflicted man or dog dreads water; on the contrary the dog has great thirst, goes where he perceives water, plunging his head therein, but is unable to lap any up, the lower jaw being paralysed. It is inexact to believe that the healthy instinctively recognizes the diseased dog. The fox, wolf and cat can become mad like a dog; the virus of the wolf is peculiarly dangerous; of one hundred and fourteen persons bitten by this animal in France, sixty-seven perished. There are authorities who assert that the bite of a mad dog is not mortal, and those who succumb do so from fear. When one has been bitten it is better to isolate and tie up the dog than to kill him, for the person can thus become assured if the animal were mad; when destroyed, the stomach of the dog ought to be examined to ascertain does it contain bits of straw, morsels of thread, &c. When bitten, the person ought to tie a string or band above the wound very tightly to prevent the virus being circulated, and to continue pouring cold water from a height for an hour, to wash out the virus, perhaps. By this time a doctor's aid shall have been obtained, either to cut away the wounded flesh or sear it with a red hot iron, or even amputate the member. Magendie and Dupuytren have shown that excessive heat is no more productive of canine madness than excessive cold. The former physiologist inoculated two dogs with the virus from an hydrophobia patient; one of the animals only went mad Canine madness or rabies does not always exist where there are dogs; it is unknown in Borneo, in regions of Brazil, in New Zealand, Tasmania and Australia according to some writers; in Constantinople where the dogs act as scavengers, and with the Esquimaux.

Connected with the Exhibition buildings there is a curiosity in the matter of ventilation. In the Champ de Mars the air rises from subterranean galleries through the floor and escapes by the lattice-work of the roof; in the Trocadero round room the cold air is pumped up from the catacombs to the fan light of the ceiling, from whence it descends and is distributed by orifices placed beneath each seat. This explains why the room can never be lighted with gas, the cold air at the ceiling would fan the flame downward; beside, it is intended only to employ the electric light. The vitiated air on the contrary is sucked upward, and escapes by the roof. The room is capable of containing 5,000 spectators, each of whom is allowed forty-four cubic yards of air; it is thus necessary to supply the hall with sixty yards of fresh air. This is effected by means of machinery, and all currents of air and draught sensations are avoided by the incoming stream being driven with a force one-sixth stronger than the outgoing, and both representing a pressure hardly superior to the external air; the latter is proportionally mixed with that of the colder, from the catacombs, to obviate chills.

The two galleries devoted to machines are the most popular part of the exhibition; they form the lateral boundaries of the Champ de Mars, constituting as it were its boulevards. They are thirty yards high and forty wide. Shafts run along the galleries, communicating the motive power to the machines; the shaft makes about one hundred and twenty revolutions per minute. The French gallery is divided into eleven groups, and the shafts, driven by five sets of boilers, represent a total of 1,300 horse-power; the foreign gallery has only five of its eleven groups occupied by machinery in motion, and four sets of boilers representing 1.055 horse-power; the aggregate total horse-power is four times greater than in 1867. Coal is the only combustible used for generating heat, and the same sun that causes the trees to grow and the flowers to bloom in the park, developed these plants that were changed into the coal now burned, ages before man's appearance on the globe. In the galleries the steam engine predominates; in the way of types there is nothing positively striking, save that they are simpler. Two types remain intact; the old balance machine of Watt, so uniformly regular in its movements and so well suited for a relatively slow speed, and the horizontal machine, with single and double cylinders, capital for quick work, cheap, but wearing rapidly and costly to keep. Though inventors claim their ameliorations to be the most superior, the engineer demands a machine that utilizes the steam in the best conditions possible. There are two camps represented by "Corliss" and the "Compound" engines; the public generally believes these names represent something wonderful in steam engines. Now a steam engine is the simplest piece of mechanism in the world; it is merely a closed cylinder in which a piston works; the steam coming from the boiler at one end pushes the piston, and when the latter arrives at the end of its course an orifice opens and allows the steam to escape into the atmosphere; at one end of this go-and-come piston is a rod connecting a crank which sets a shaft in motion. Such is the steam engine. All improvements in the latter have two ends in view, to economize the power of steam when entering and when within the cylinder, and to produce the greatest

amount of steam at the smallest expenditure of combustible, or, in other words, to prevent the loss of heat. The Corliss condensing engine utilizes the steam in a very effective manner. Engines expend more steam in practice than they ought to do theoretically, the difference ranging from fifty to sixty per cent. This loss is attributed to the manner in which the steam is distributed on entering the cylinder, and its condensation on the sides even of the cylinder itself. To prevent the cooling tendency of the latter, Watt had the cylinder surrounded by an envelope of steam, and his idea though then discarded has been of late years taken up. The "Compound" engine deals with this fact, and the thousands of machines constructed on the principle, explains its practical success. The system is about being applied to locomotives by M. de Freiniuville. It has been demonstrated that heat and force are synonymous; so much heat, so much force. The best machines require about two pounds of coal per hour per horse-power; they do not transform in work more than eight or ten per cent. of the heat produced in the furnace; in ordinary steam engines it descends even to five and two per cent.; the loss is thus ninety-five per cent! This enormous waste is produced on all sides, in the furnace, the boilers, &c. The gas machines, very imperfect in point of construction when compared with a steam engine, produce a relative amount of work at three-fourths less of heat, because the furnace or center of combustion is inside the machine, and the waste or leakage of heat is thus reduced. Hence, while steam engines are nearly perfection, the apparatus for generating heat and storing the steam is still in its infancy.

Since a century, persons have labored to discover a motive power other than steam, and the Exhibition proves that the gas engines of Messrs. Otto & Simon can practically cope with the steam engine as far as to five horse-power. The Otto is an air machine, heated by ordinary gas, inside the cylinder even. It consumes not more than a thousand quarts of gas per hour and per one horse-power, and requires only thirty-five quarts of water to keep the cylinder cool. The success of the gas engine has cut out warm air as a motive power; indeed the former is only a heated air machine perfected. Hydraulic engines are useless in towns where water costs so dear, where they could only be adopted by workmen laboring in their own houses. Electricity is not to be thought of as a motive power; by simply turning a magno-electric machine a great deal of electricity is generated by a small expenditure of force; but the opposite fact is true, that with a great deal of electricity very little motive power is produced. The electric piles only work by oxydizing zinc, and expend as much zinc as a steam engine does of coal. Now zinc is fifteen times dearer than coal, and yields three-fifths less of force; its cost then would be about thirty times dearer than coal. At the present stage of mechanical science, therefore, the best motive power for great engines is steam, and for small machines, gas.

Dr. Donnē, whose recent death science has to deplore, was a great advocate of milk as a curative agent. The present Count de Paris, when two years of age, was given up as a lost child; the Doctor was allowed to experiment as he

pleased, and quickly restored the health and strength of the child, now a very robust man. It was Donnē who demonstrated that fresh milk is always alkaline; his advice to mothers was sound: "never rear your infant yourself when you cannot, if you desire to save it from rickets, scrofula and consumption."

Some posthumous papers have been found, a series of notes, the last written by Claude Bernard, asserting that M. Pasteur's theories on fermentation are erroneous, and that germs of fermentation do not come from the external air. This raises the question of spontaneous generation, with Bernard in its favor. But the friends of Claude Bernard suggest that the notes found were only intended as a programme of experiments contemplated; if such were not their aims, M. Pasteur objects to C. Bernard's views, and invites his friends to come and test their practical contradiction in the laboratory. It is a great problem, not in the sense of spontaneous generation, for Pasteur maintains life is the product of antecedent life created by a supreme will, but of contagious affections and decomposition, for fevers and such ailments are generally believed to be the product of germs floating in bad atmospheres. F. C.

THE FOSSIL INSECTS OF COLORADO.

MANHATTAN, Kansas, September 2, 1878.

Editor of the Western Review:

The remarks of Prof. C. E. Robins, on page two hundred and seventy-six, of the August number of the REVIEW, call for an explanation. My statements on the fossil insects and plants found by me in South Park, were not written out by me, but were a *very condensed* report of what I said in a lecture before the Kansas Academy of Science. The report should have stated that the insects and plants were of a semi-tropical character, such as now could live in a country like Florida, on a level with the ocean; and, consequently, such species could not live in the latitude of Pike's Peak, at an altitude eight thousand (8,000) feet above the sea. Prof. Robins will readily recognize the fact that classes of insects, from such diverse surroundings, always have a different aspect; the ants from the tropics and temperate zones illustrate this trait, or type, of animal life.

I also stated that the difference of climate, which would allow semi-tropical insects and plants to live where we found them, could be explained by allowing the Rocky Mountains to have arisen less than half of their present altitude, leaving the "plains" under the ocean. The Rocky Mountain region would then have existed as a cluster of islands, with wide oceans on all sides. If warm currents had then flowed, as in the Gulf stream, from the tropics, the South Park, being on a level with the sea, would have had a semi-tropical climate, and would naturally have been supplied with insects and plants of the kinds we find fossilized.

The total vertical thickness in which we find these fossils is two hundred feet, the material consisting, for the most part, of fine sand, clay and lime. This

gives us some idea of the long period during which the mountains stood still in their upward motion, or moved so slowly that all this sediment could have been deposited while the level of South Park was not so much above the ocean as to affect its climate.

These deposits are all horizontal and undisturbed. This gives us another lesson on the growth of mountains, viz: that the subsequent upraising of about eight thousand feet must have been slow and gradual, without convulsions, or these frail insects could not have been preserved in such delicacy. Prof. S. H. Scudder finds the most minute down, or feathers, on the wings of the butterflies, still preserved. The fine net veins on the leaves of the Dicotyledonous plants are as clearly retained as on a leaf from a growing tree; all the facts point to a slow upraising of the mountains, amounting to only a few feet in a century.

I do not claim to be authority on entomology and botany, as those sciences are not my specialty; Prof. Scudder has visited the spot, and the plants have been sent to Prof. L. Lesquereux, and both concur as to the semi-tropical character of the fossils. Yours respectfully,

B. F. MUDGE.

ELEVATION OF KANSAS RIVER.

Editor of Western Review of Science and Industry:

As a matter of some interest to your readers, I herewith give you the monthly average elevation of the Kansas river above low water of 1874. This average is obtained from the daily record kept by myself at the Kansas City Stock Yard Exchange building, from June 10th, 1877, when it stood at twenty-six feet, three inches, the highest since 1844 to the present time. The record is as follows:

1877.	ft.	in.	1878.	ft.	in.
June	20	7	January	6	11
July	16	11	February	10	3
August	10	3	March	8	4½
September	6	11	April	9	11
October	6	11	May	13	7½
November	6	8	June	19	0
December	7	4½	July	18	6½

Respectfully Yours,

H. P. CHILD.

METEOROLOGY.

MISSOURI WEATHER SERVICE, SEPTEMBER, 1878.

BY FRANCIS E. NIPHER, DIRECTOR.

At the St. Louis station during the past September, the average temperature has been 68.9°, the normal temperature being 69.1°. The extremes of temperature were 88° on the 8th, and 44° on the 12th. In 1864 Dr. Englemann observed a September temperature of 102.5°, while in 1839 a temperature of 35° was noted.

The temperature of the month was therefore normal. In the State the mean temperature has been, at Corning and Oregon, 66.7°, Boonville, 67.8°, Lebanon, 67.2°, Kansas City, 68.5°, Lexington, 69.1°, Neosho; 68.7°.

On the 11th frost was observed over the region north of a line drawn through Sedalia and Hannibal (M. K. & T. R. R.,) while on the 12th and 13th the frost line passed through Neosho and St. Louis, being marked approximately by the St. Louis and San Francisco R. R. On the 21st and 26th the frost line is marked by the Missouri river. Ice is reported to have formed at Big Creek, (south of Lincoln county) on the 12th and 21st, but was observed at no other station. Vegetation is everywhere unharmed on the uplands.

On the 23d a hail storm at Macon covered the ground with hail stones about three-eighths of an inch in diameter. At the central station the rain-fall has been 3.93 inches, an excess of 0.94 inch over the normal rain-fall. In 1871 the September rain-fall was only 0.02, while in 1866 it reached 10.53 inches. Ten times in forty-two years the September rainfall has exceeded that of last September.

In the State the area of greatest rain-fall (over three inches) is bounded by the Iron Mountain and the St. Louis and San Francisco railroads, while the belt of least rain extends along the Missouri, Kansas & Texas R. R., including also the northeast part of the State. In the northwest part of the State, the rainfall again exceeds two inches.

Observers who do not note the time of beginning and end of rains, are earnestly requested to do so, as it will double the value of their work.

KANSAS WEATHER REPORT FOR SEPTEMBER, 1878.

BY PROF. F. H. SNOW.

STATE UNIVERSITY, LAWRENCE, KANSAS.

Mean temperature, 67.58°, which is 1.02° above the average September temperature for the ten preceding years. The highest temperature was 94.5° on the 4th, the lowest, 41° on the 11th. There was no frost at our station, though a very light hoar frost was observed on the low lands in some portions of Douglas county. The mean temperature at 8 a. m., was 61.17°, at 2 p. m., 79.18°, at 9 p. m., 67.58°. The mercury reached 90° on six days. The highest average temperature (79°) was reached on the 30th.

Rain, 2.51 inches, which is 0.70 inch below the September average. Rain fell on seven days. There were two thunder showers. The entire rain-fall for nine months of 1878 now completed has been 34.51 inches, which is 5.68 inches above the average amount for the same period for ten years.

Mean cloudiness, 30.66 per cent of the sky, the month being 3.37 per cent clearer than usual. Number of clear days, 19 (entirely clear, 7); half clear, 7; cloudy, 4; (entirely cloudy, none).

Wind, southwest. 34 times; southeast, 19 times; northwest, 18 times; north, 6 times; east, 5 times; northeast, 4 times; south, 3 times; calm, once. The entire distance traveled by the wind was 12,245 miles, which gives a mean daily

velocity of 408 miles, and a mean hourly velocity of 17 miles. The highest velocity was 45 miles an hour, on the 30th, on which day the total distance registered was 969 miles.

Relative humidity, mean for the month, 66.4; at 7 a. m., 30.8; at 2 p. m., 44.7; at 9 p. m., 73.7. Greatest, 94.4, on 19th; least, 31.7, on the 16th. There was no fog.

COLORADO WEATHER REPORT—SEPTEMBER, 1878.

BY PROF. C. E. ROBINS, SUMMIT, COLORADO.

Highest temperature, 61°; lowest temperature, 20°; mean temperature, 35.7°; total snow-fall, 5 inches; total rain-fall or melted snow, 1¼ inches; prevailing wind, west; maximum velocity, 40 miles an hour; number of days on which rain or snow fell, 11; number of cloudy days, 6.

A brief summary of an attempt to grow vegetables at an altitude of 11,300 feet (lat. 37° 28′ 18″ N., long. 106° 30′ W.) may be worth setting down:

June 14; so soon as ground was clear of snow, radish and turnip seeds were sown. June 26; maize, Mexican beans, dwarf peas, Irish potatoes, beets, kohl rabi, nasturtium, parsley and spinach seeds planted. June 29; lettuce sown. July 13; peas up. July 20; potatoes up. July 25; corn, beets and spinach up. July 31; radishes ripe. August 1; nasturtiums up. September 1; frost destroyed maize, Mexican beans, nasturtiums and foliage of potatoes. September 7; ground covered with snow. September 9; Heavy frost, blighting tops of peas and beets. September 20; everything in garden dead except lettuce and spinach, latter holding out best.

Radishes (roots) grew to be 5 inches long and ½ in. thick; turnips, to be ¾ in. in diameter; maize (stalks), to be 3 in. high; Mexican beans, ditto; peas, 5 in. high and blossomed, no fruit; potato stems, grew to be 6 in. high, ¾ in. longest diameter of tubers; beets (roots), 4 in. long ⅛ in. thick; kohl rabi and parsley did not come up; nasturtiums grew to be 1½ in. high; spinach and lettuce grew 3 in. high and show about one-half green and one-half dead leaves at this date, 1st October. No snow on ground.

BOOK NOTICES.

Electric Lighting. By Hippolyte Fontaine. Translated from the French by Paget Higgs, LL. D. E. & F. N. Spon, London and New York, 1878; pp. 194, octavo. Cloth; fully illustrated. For sale by M. H. Dickinson.

When Alessandro Volta, a little more than one hundred years ago, invented the electrical instrument named after him, the Voltaic Pile, it probably would have been regarded by him as impossible that its capabilities, or rather those of

the Voltaic arc, should ever become so developed as to become the most efficient means of illuminating immense factories, whole streets of cities, etc. Such, however, is the fact, and the work above named is devoted to recording the history of Electric lighting from the time of Sir Humphrey Davy, who was the first, in 1813, to observe the Voltaic arc, down to the experiments of King, in 1847; Le Roux, in 1867, and Jablochkoff, in 1877. Any one who has only had his attention called to the subject by the recent numerous discussions of it in the newspapers, will be surprised, upon reading this book, to find that as long ago as 1846 the electric light was introduced at the Opera in Paris, and has ever since been used, producing the magnificent effects of the rainbow, lightning, sunrise, luminous fountains, etc., and that from that time to this it has been found of increasing value in illuminating mines, railway works, the docks and harbor of Havre, the Paris Exhibition of 1878, in the Trocadèro and in many other extensive works where continuous labor, day and night, was necessary. The amount of ingenuity, labor and time which have been expended and wasted upon electric lamps since 1844 is perfectly appalling, and no experimenter on the subject should devote another hour to it without first consulting M. Fontaine's work, and there, by reading the numerous descriptions of carbon regulators—whether failures or not—learning to avoid repeating the errors of hundreds, who have gone before them and failed, or giving way to impracticable ideas.

The various branches of the subject such as electric lamps, electric carbons, magneto-electric machines, the Gramme machine (which seems to have been applied to nearly all kinds of industrial and mechanical machinery and has been found especially adapted, as the author claims, to the production of electric light for factories, forts, light-houses, ships, &c.,) cost of electric lighting and divisibility of electric light—all are treated fully and attractively, and with great apparent candor.

Certain it is that the subject is one whose adaptability to the requirements of society is yet far from fully developed, for while M. Fontaine remarks that "there is at the present time (1878) no sufficiently practicable system of dividing the light as to render it generally available for the purposes for which gas is used," our Prof. Edison has nearly or quite succeeded in dividing it so as to make it applicable to the dwelling house as well as the street and work-shop.

Among the advantages of the electric light over that of gas, candles or kerosene are those of hygiene, since it consumes no fresh air, while all of the others consume it enormously; economy, since at the present price of gas, even at its cheapest, the cost of the electric light is far below it; certainty of production, since, while the materials for producing gas may fail, those required for the other are always present in inexhaustible quantity; and lastly, perfection of illumination, since it does not alter even the most delicate shades of color, whether of vegetation, fabrics or ladies' complexions, and at the same time penetrates the densest fogs of the sea coasts.

The Messrs. Spon have spared no pains to make this book itself attractive in typography, illustrations and binding.

SCIENTIFIC MEMOIRS. By John William Draper, M. D., LL. D. New York, Harper & Brothers, 1878, pp. 473, octavo. Illustrated. For sale by M. H. Dickinson, $3.00.

For more than forty years Dr. Draper has been a hard student, careful investigator and prolific writer upon scientific subjects. The first of his works brought to our personal observation was his treatise upon Human Physiology, published more than twenty years ago, which at that time was regarded by the profession as by far the most advanced work which had been put forth on the subject, containing, as it did, the results of many experiments and explorations new to the world. Even yet this work maintains a high position among kindred works.

The volume under consideration includes only certain papers connected with the effects of Radiations or of Radiant Energy, which have been published in various journals, pamphlets and transactions of learned societies in different parts of the world, and which have never before been brought together. These papers were awarded the Rumford medal by the American Academy of Science for discoveries in light and heat, and probably comprise more original research and ingenious and successful experimentation in these branches of physics than any other series in use.

While sufficiently technical for the most scientific reader, these papers are written in an admirably easy and perspicuous style, so that they become clear and attractive to the ordinary reader. For instance, the chapters upon the examination of the radiations of red hot bodies, the production of light by heat, spectrum analysis, photography, the electro-motive power of heat, the cause of the flow of sap in plants and the circulation of the blood in animals, are equally interesting to the *savant* and the college student, while all the others, though perhaps more abstruse, are full of instruction to those interested in the subjects discussed. Among these may be mentioned the chapters on the diffraction spectrum, the effects of heat upon phosphorescence, analogies between the phenomena of the chemical rays and those of radiant heat, the chlor-hydrogen photometer, &c.

The work is profusely illustrated and is gotten up in Harper Brothers' best style, which, with the well-known reputation of the author as a life-long investigator, a most accurate observer, and as a writer possessed of an elegant style and profound stores of learning, will certainly give it a large circulation among reading people.

THE DRUGGIST'S RECEIPT BOOK. By Henry Beasley. Philadelphia, Lindsay & Blakiston, 1878; pp. 510, 12 mo., $2.50.

This work, now in its eighth edition, comprises a copious veterinary formulary, numerous recipes in patent and proprietary medicines, druggists' nostrums, perfumery and cosmetics, beverages, dietetic articles and condiments, trade chemicals, scientific processes and an appendix of useful tables, foreign weights and measures, chemical symbols and equivalents, etc., etc.

It is exactly what all apothecaries and pharmaceutists need for daily reference and for valuable instruction in the art of compounding medicines and chemicals, and especially will it be found useful in the West where the druggist is frequently the doctor, and *vice versa*, and both are expected and frequently compelled to prepare and dispense medicines of all kinds. Besides this there are many recipes and directions for the preparation of dietetic articles for the sick, which are indispensable in the household, not to mention the numerous formulas for preparing medicines for horses, cattle, sheep, dogs and poultry, which render it important to the farmer and stock raiser. For the money, it is the most comprehensive and complete work of the kind we have ever seen.

ON THE PLAINS AND AMONG THE PEAKS. By Mary Dartt. Philadelphia, Claxton, Remsen and Haffelfinger, 1878; 12 mo., pp. 237. Cloth, $1.00; paper, 50 cts.

The collection of the animals and birds of Colorado, shown by Mrs. Maxwell at the Centennial, attracted so much attention on account of its extent, the skill of the taxidermist who prepared them and their artistic arrangement, that it was found necessary to prepare a little history of the whole collection and its owner to avoid the wear and tear of answering the innumerable questions of the sight-seers who crowded the Kansas and Colorado building.

The above book is thus accounted for, and purports to give an account of how Mrs. Maxwell became a naturalist, how she made her collection and of many of the incidents connected therewith. It is written in a natural and piquant style and is full of wild scenes of adventure and danger which attended her pursuit and capture of most of these animals, for it must not be forgotten that Mrs. Maxwell hunted, shot and stuffed nearly all the animals in her wonderful collection, from the grizzly bear to the turkey buzzard, and that such feats are not easy of accompiishment even by the most experienced and hardy hunter.

In an appendix, Dr. Elliott Coues, U. S. A. and Prof. Robert Ridgway give complete technical lists and descriptions of all the animals and birds in this remarkable collection, which lists occupy more than ten pages. The work will abundantly repay the general reader, while the appendix gives valuable information to the naturalist and the sportsman.

HOW TO BE PLUMP. By Dr. T. C. Duncan. Chicago, Duncan Brothers, 1878; 12 mo., pp. 60. Cloth, 50 cents.

This is a little book on a large subject, but one that is much needed in society, where the tendency of its members generally is to unnatural and ungainly leanness. The rules laid down are altogether physiological and hygienic, and if carried out faithfully will accomplish the desired object. It should be read and studied by all mothers and fashionable ladies, but especially by those who are growing thin from any cause.

OBITUARY NOTICES.

PROF. F. W. BARDWELL, M. A., C. E.

Prof. Bardwell will be remembered by our citizens as one of the members of the Kansas Academy of Science present at its semi-annual meeting in this city last summer. His address delivered at that time upon "River Navigation," was a masterly effort, and his genial manners made him many friends. Since then he has published a pamphlet upon "The Method of Arithmetical Instruction," and more recently an exhaustive work of Arithmetic.

Prof. F. H. Snow, President of the Kansas University, writes as follows:

"I enclose a brief account of Prof. Bardwell, from the Lawrence *Journal*, received a day or two ago. I know of no other facts in his life of interest to the public generally. His death is a great loss to the University and a personal bereavement to myself, as our relations were of the most intimate character. I left him three weeks ago on a sick bed, but did not apprehend a fatal result. He was then suffering keen disappointment that he had not been able to take observations upon the eclipse at Pueblo, where he had put up his instruments. But we know not what a day may bring to us, and I am confident that all is well with him."

"At twenty minutes before two o'clock, Saturday afternoon, Professor Frederick W. Bardwell, professor of astronomy and engineering in the University of Kansas, died at his home in this city, at the age of forty-six years, after an illness of only about three weeks. The sad announcement, though there had been much forewarning of its approach, fell with crushing severity upon the minds of our people. Prof. Bardwell, since his coming to Kansas, has been recognized by all classes as a scholar of great accomplishments, a citizen of model deportment and a gentleman of perfect quality. Those who have enjoyed his personal friendship have found in him rich stores of that frankness, sincerity, gentleness, and genuine uprightness of character which alone can make a friend in name a friend in fact. In the University he was one of the strongest members of the faculty, and it is there chiefly, perhaps, that he will be missed and mourned.

"Prof. Bardwell was born in Belchertown, Massachusetts. His father died when he was four years old, after which event he lived with relatives until the twelfth year of his age. After that date he earned his own livelihood, working on farms in the summer season, and in the winter time either going to school or teaching, as circumstances permitted. In this manner he worked himself through Harvard College. In this time also he was employed much on the Nautical Almanac, a scientific work of much importance.

"After graduating from Harvard, Prof. Bardwell accepted a professorship at Antioch College, Yellow Springs, Ohio, of which institution Horace Mann was then president. Before Prof. Bardwell left Antioch, President Mann was succeeded by Thomas Hill, since President at Harvard. With both these men Prof. Bardwell was associated on the most intimate terms.

"When the war opened, Prof. Bardwell left Antioch to enlist as a private. He was soon promoted, however, and was finally made colonel. At the close of

the war, in company with others, he went into the culture of cotton on a Florida plantation, withdrawing after three years of ill success. It is told in this connection that every man of the many laborers in his employ was paid fully, though he himself was left with absolutely nothing, save, of course, a mind conscious of its own rectitnde.

"From Florida Prof. Bardwell returned to Massachusetts, and was soon called to a position in the Naval Observatory at Washington, where he did excellent work for two or more years. His health there was not good, and thinking to improve it, he accepted the proposed professorship of mathematics in the University of Kansas. By a recent promotion he was made professor of astronomy and engineering—the chair now made vacant by his death."

THOMAS BELT, F. G. S.

Pleasant Hill, Mo., Sept. 28, 1878.

Mr. Case, *Dear Sir:*—I was shocked to see a notice a few days ago of the death in Kansas City on the 21st, of Mr. Thos. Belt, F. G. S. I met him in St. Louis in 1874. Since then he sent me an interesting paper on "Niagara Falls, its Surface Geology," showing that he had studied it very closely, and at a subsequent visit I found his pamphlet of much use. He has written much on glaciers and investigated their effects all around the world. He sent me from London a volume of his work entitled "The Naturalist in Nicaragua," a very interesting book giving an account of his residence there for over two years while superintending some gold mining operations there for an English company.

Less than two months ago I received letters from him in which he spoke of his studies in the drift of Colorado, of a skull he had found there, and he expected to have had a paper prepared for the American Association for the Advancement of Science, on the subject, but failed in completing the details.

It is hoped that ere his insane spell came on he had completed this work. He was one of the best authorities on glaciers. Some of his papers may be found in the proceedings of the Geological Society of London. His death is a great loss to science. Respectfully, &c.,

G. C. Broadhead.

Mr. Belt was a man of rare attainments and said to be one of the finest mining experts in the country. He represented certain English capitalists, interested in mines, who have depended upon his investigations and advice in investing money in mines in different portions of the globe, from Australia to the Rocky Mountains. He had but just returned from a business trip to Deadwood, where he was much exposed, resulting probably in inflammation or congestion of the brain. For several days before his death he was quite insane, his madness taking the form of harangues on scientific subjects, which, though wild and eccentric in manner, manifested a high degree of scholarship and knowledge of the subjects. He was about thirty-eight years of age and a man of great energy and ability. He had published several pamphlets beside the works mentioned by Prof. Broad-

head above, among which were "The Glacial and Post-Glacial Phenomena of Niagara," and "An Examination of the Theories that have been Proposed to account for the Climate of the Glacial Period."—Ed.

DR. AUGUST HEINRICH PETERMAN.

This distinguished man died of apoplexy, at Gotha, Germany, on the 27th of September, after a very active life devoted almost exclusively to geography. He was born in April, 1822, near Nordhausen in Prussian Saxony, and was consequently but in the prime of life. He was educated at Potsdam and remained there a number of years acting as private secretary for the famous Professor Berghaus, and assisting in the preparation of his "Physical Atlas." Subsequently he prepared a map of Central Asia for Humboldt, of whom he was a warm friend. In 1845 he was in Edinburg assisting Prof. H. K. Johnson with his "Physical Atlas," and in 1847, at London, united with Rev. Thomas Milner in preparing a "Physical Geography." While there he became a member of the Royal Geographical Society, and contributed valuable accounts of the progress of Geography to the *Athenæum.* African exploration owes much to him, while his hypotheses in regard to an open polar sea were supported by Dr. Kane's discoveries. In 1854, at the age of thirty-two, he was given the chair of Geography in the University of Gotha, and soon after had conferred upon him the title of Ph. D. by the University of Göttingen. He subsequently superintended and published a monthly Journal of Geography at Gotha, called the *Mittheilungen*, which, up to the time of his death was regarded as the standard authority of the world on this subject. An exchange says:

"It was from his diligent examination and comparison of thousands of log books that the course of the Gulf Stream, as at present recognized, was mapped out, and his death seems even yet more inopportune and sad, because it has occurred so soon after Captain Coffin, of the brig "Dirigo," has impugned the accuracy of some of his calculations, and before he could possibly have time either to lay down an amended chart or prove the errors of Coffin's statements."—Ed.

EDITORIAL NOTES.

On the 27th ult. Maj. F. G. Adams, secretary of the Kansas State Historical Society, in company with Dr. Fryer of the United States army and Dr. R. J. Brown and several other members of the Academy of Science of Leavenworth, visited a spot on the high ridge west of Fort Leavenworth known as Sheridan's Drive, to look for the traces of the Mound-builders described by United States Surveyor McCoy in 1830. The spot described in the report was found at a point about one mile west of Fort Leavenworth, and after some work among the undergrowth of hazel bushes six mounds of small size were discovered. One of them was opened, and at a depth of four feet two stone walls parallel to each other about six feet apart were found, and at one place an arched covering of stone. The in-

ner sides of the rocks, which had evidently been carried to the top of the ridge, which is about twelve hundred feet above the sea level, indicated that they had been subjected to an intense heat at some time. Much interest is manifested in the reports of the exploration among scientific men of Kansas, and a thoroughly organized force will make further excavations soon, when it is thought much of scientific importance will be developed. These are believed to be the first unmistakable traces of the Mound-builders discovered west of the Missouri river with the exception of one or two mounds in Jackson county, Mo.

WE are indebted to Captain Howgate, U. S. A., for an illustrated copy of his Memorial to the 45th Congress in behalf of an appropriation for the support of an exploring expedition to the Polar regions of North America. It seems to be a stigma upon our national reputation for enterprise and energy that Congress should be so long in making the small appropriation asked, when other nations, less directly interested, and even private individuals, are doing and have done so much in the cause. Doubtless, however, the appropriation will be made during the coming session and the expedition started early next Summer. In the meantime the Florence, sent out by Capt. Howgate last year to prepare the way for the expedition expected to be provided for by Congress shortly afterward, has been announced as returning home, and Capt. Tyson and his brother officers will be able to furnish all the necessary information required to render such an appropriation most useful and effective, at the same time that Messrs. Sherman and Kumlein, the naturalists who accompanied the expedition on the part of the Smithsonian Institute, and who have, according to the report brought in by Captain Roach of the Helen F., devoted themselves most assiduously to the objects for which they were sent out, will be enabled to give additional scientific reasons for a thorough national exploration of this the modern *Ultima Thule.*

WE have received numerous complimentary letters from scientific gentlemen in different portions of the country lately, commenting favorably upon the quality of the articles furnished in the REVIEW and its general style and make-up; also, many handsome notices by our friends of the periodical and newspaper press on both sides of the Atlantic, which evidences of favor are, of course, highly gratifying to us and well calculated to stimulate us to still greater efforts to make the REVIEW a worthy medium for giving to the public the best thoughts and experiences of western scientists.

THE oldest specimens of wrought iron known to ethnologists are believed to be certain sickles found by Belzoni under the base of the Sphinx at Carnac, in Thebes. Another fragment found by Captain Wise in the Great Pyramid, and the piece of a saw dug up by Layard at Nimroud, all of which are now in the British Museum, prove that iron and the art of forging were known much earlier than has been supposed, and that the secret of manipulation appears to have been held very closely for many years before it came into general use.

The oldest specimen of steel is believed to have been a Damascus blade presented by King Porus to Alexander the Great.

THE French Academy of Science at its last meeting, July 29, elected the veteran American botanist, Prof. Asa Gray, corresponding member of its botanical section, by 35 votes out of 40, Mr. Charles Darwin, the other candidate, receiving the other five.

M. MARIGNAC, a French chemist of high standing, questions the existence of Mosandrium, the supposed newly discovered elementary substance announced by Prof. J. Lawrence Smith, and named by him after Mosander, whose researches in this class of metals are well known, pronouncing it merely Terbium. Prof. Smith is good authority on these subjects, and not likely to make an announcement so easily upset.

THE article in this number entitled "Pottery found in Missouri Mounds," is condensed from Chapter IX of Mr. Conant's admirable essay upon the Archæology of Missouri in

"The Commonwealth of Missouri," and the cuts illustrating it were kindly lent us for the purpose by Mr. C. R. Barns, the editor of that fine work. The entire essay will soon be published in pamphlet form by Mr. Conant, and will form a most interesting and valuable contribution to the literature of western Archæology.

THE *Inter-Ocean* of October 3, says that Superintendent Colbert, of the Dearborn Observatory, has been making observations relative to the new planet Vulcan with the great telescope, and making calculations as to its orbit. These calculations up to yesterday morning give a synodical period of 24,774 days, giving a siderial period of 23.2 days—mean distance 0.1592, corresponding to 14,700,000 miles from the sun's center. These calculations are especially interesting, as they agree, we learn, with the following calculations of other astronomers, namely: Sidebotham, March 12, 1849; Leacerbaulb, March 26, 1859; Lummis, March 20, 1862; Weber, April 4. 1876. Also gives Tice's transit at another node, September 15, 1859, and agrees with positions as seen at Denver, July 29, 1878.

OUR friends of the Leavenworth Academy of Science have published the following attractive programme for the Winter course, viz:

October 10, The Historical Value of Linguistic Study, Prof. D. H. Robinson, of the State University; October 24, Review of some of the Modern Theories of Creation, Rev. Wm. Smith; November 7, Spectrum Analysis, W. E. Coleman; November 21, The Constitution and its History, Judge Robert Crozier; December 5, Spectrum Analysis of the Heavenly Bodies, W. E. Coleman; December 19, The Four Great Dynasties of our Planet, Rev. W. W. Backus; January 9, The Impending Revolution, W. S. Burke; January 23, Chemistry in the Arts, Prof. G. E. Patrick, of the State University; February 6, Classical Study, Prof. W. W. Grant; February 20, The Political, Educational and Religious systems of Europe and America Compared, Rev. Wm. N. Page; The Geological History of Pilot Knob, R. J. Brown; March 6th, Ethnology, Prof. H. D. McCarty; March 20, Municipal Indebtedness, Judge D. J. Brewer; April 3, The Harmony of Science and Religion, Rev. Thos. W. Barry; April 17 and May 1, Physical Geography, Tiffin Sinks, M. D.

PROF. H. CARRINGTON BOLTON, of Trinity College, Hartford, Conn., and Prof. F. W. Clarke, of the University of Cincinnati, both well-known chemists and writers, have placed us under obligations by sending us copies of articles published by them, respectively, viz: The Behavior of Natural Sulphides with Iodine and other Reagents; and On Some Seleniocyanates and the Electrolytic Estimation of Mercury; also by some very cheering and complimentary remarks upon the REVIEW and more than all, by promises of original contributions to its columns at some time not far distant.

THE following pamphlets and scientific articles have been received since our last issue, which will be hereafter published in full or in a condensed form, viz: The 205th Anniversary of the Exploration of the Mississippi River in 1673, by Marquette and Joliet, being an address by Hon. W. F. Switzler, delivered in St. Louis, July 19, 1878; Report of the Committee of the Engineers' Club of Philadelphia on the Metric System of Weights and Measures, April, 1878: An account of Holland's Hydro-carbon Retort and Oxy-hydrocarbon Illuminator; Prospectus of Strecker's Butterflies and Moths of North America, published at Reading, Pa., price $2.00; Prospectus of the American Quarterly Microscopical Journal, edited by Prof. Romyn Hitchcock, N. Y., price $3.00 per annum; Speech of Hon. Otho R. Singleton of Miss., on the Hayden Surveys; Monthly Reports of the Kansas State Board of Agriculture for May, June, July and August, 1877, filled with the most valuable statistics, by Alfred Gray, Secretary.

WE are indebted to Messrs. Houghton & Osgood for copies of the "Atlantic portraits" of the poets Bryant and Whittier. They are of life size, and similar to that of Longfellow published some three years since by the same firm, and are intended solely as premiums to subscribers to the *Atlantic*, to whom they are furnished at $1.00 each. Being faithful life-likenesses and most excellent works of art, they make a far more appropriate ornament for a library or parlor than the chromos usually found there. Having been handsomely

framed in walnut and gilt by Findlay, these fine engravings may be seen at his store for a few days.

Notes on Periodicals Received.—Aside from the usual variety of literary articles and tales, the monthlies are all devoting a portion of their space to scientific matters. For years past *Harpers' Monthly* and *Weekly* have done this, and their "Scientific Notes and Record" are now regarded as one of the important features of both, being edited by distinguished scientists, and subsequently incorporated into Prof. Baird's Annual Record of Science and Industry. *Scribner* also makes a special department of scientific matters under the head of "The World's Work," while *Appleton's Journal* almost always has one or more well-written articles of a scientific character, and *The Atlantic* manages to make up a portion of the "Contributors' Club" by discussions of questions in some of the branches of natural history. The Eastern dailies as well as the agricultural, literary and religious journals, east and west, are also giving more and more space to such reading, and it is to be remarked that it is apparently crowding out much of the trash formerly published by them.

The *Atlantic* for November will give its first place to a paper of unique value and interest on the Origin and Aims of the National or Workingmen's party, by the author of the powerful leading article in the October number. Mr. Brooks Adams will contribute another paper on financial conditions. The first of two essays on Florence and her great Cathedral, by Professor Charles Eliot Norton, will follow, with the conclusion of the Reminiscences of Brook Farm, a Letter from the Paris Exposition, the beginning of a new story by W. D. Howells, and a short story of Tennessee life, poems, reviews, literary essays, etc. Subscriptions received for the *Atlantic* and Portraits, also for the *Postal Guide* at this office.

The *International Review* (A. S. Barnes & Co., N. Y.,) for September-October, contains among other excellent articles, one by Selah Merrill, archæologist of the Palestine Exploration Society, upon Pilgrim Caravans of the East, which gives one a better and more satisfactory idea of these pilgrimages to Mecca and Medina, both in their external and internal phases, than any book of travels or sketch of Eastern life we have seen.

The critical remarks of General Millen upon Stanley's operations and discoveries in Africa are also very just and appreciative, and give, in a few pages, the full scope and outline of the great traveler's best work, "Across the Dark Continent."

The September-October number of the *North American Review* (D. Appleton & Co., N. Y.,) contains the following articles: "Is the Reformer any longer needed?" by George W. Julian. "The Readjustment of Vocations," by William T. Harris, LL. D. "Torpedo Warfare," by D. D. Porter, Admiral U. S. Navy. "What is Inspiration?" a symposium, by Rev. F. H. Hedge, D. D., Rev. E. A. Washburn, D. D., Rev. Chauncey Giles, Rev. J. P. Newman, D. D., Most Rev. James Gibbons, D. D., Archbishop of Baltimore, and John Fiske. "Civil Service Reform," by John Jay, Chairman of the Commission on the New York Custom House. "Alfred de Musset," by T. S. Perry. "Kin beyond Sea," by the Right Hon. W. E. Gladstone, M. P. "Contemporary Literature."

Harper's Monthly for October, contains in addition to its usual variety, a most interesting account of the greatest piece of civil engineering in the world—the St. Gothard Tunnel, illustrated with fine wood cuts showing the magnificent scenery of the Swiss Alps, the intricate and ingenious machinery used in the work, and portions of the Tunnel itself. It is a description which will be read with the greatest interest by grave engineers, as well as by wonder loving readers of all ages.

The Boston *Journal of Chemistry* is, as we have had occasion to say before, one of the best and oldest periodicals of the "popular science" class in this country. Its editorials are ably and entertainingly written upon subjects of current interest, and its general scope renders it essentially a household work, to which also its low price materially contributes.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND AGRICULTURE.

VOL. II. NOVEMBER, 1878. NO. 8.

PALÆONTOLOGY.

ON THE DERMAL COVERING OF A MOSASAUROID REPTILE.

(*Liodon dyspelor* Cope).

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

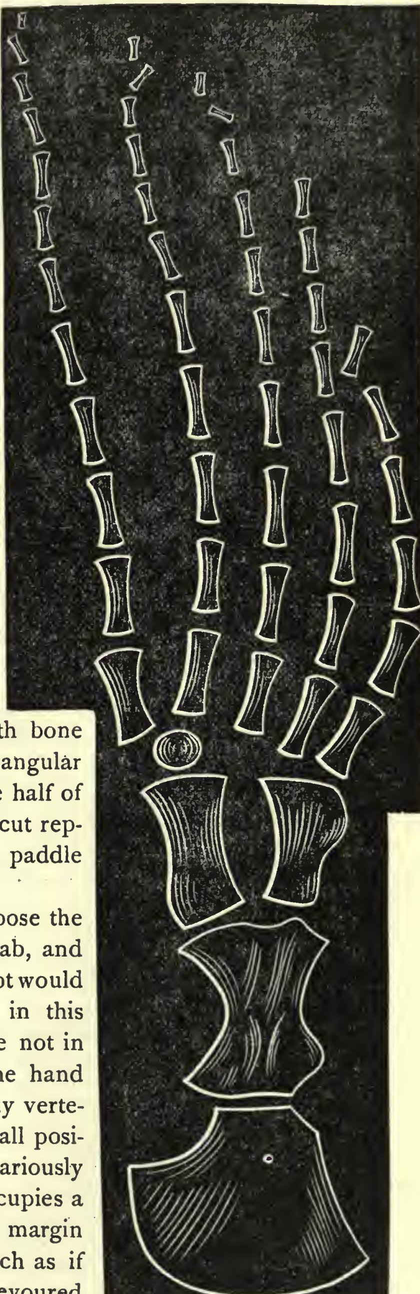
The geological section of the Kansas University scientific expedition for 1878, in charge of Professor B. F. Mudge and the writer, examined with care a portion of the blue-gray shales and the yellow limestones along the Hackberry creek, in Gove county, Kansas. These rocks belong to the Niobrara group of the cretaceous formation. The locality had been previously visited by several parties of geological explorers, who had obtained from it many valuable fossils, and it was hardly expected that the gleanings from a field so thoroughly worked would contain anything of unusual value. But the frosts and rains of a single year had exposed to view many remains of fishes and saurians, and our labors were unexpectedly and abundantly rewarded. In less than three weeks, 41 saurians, 117 fishes and 6 pterodactyls (Pteranodonts), were discovered, many of them in almost perfect condition, and all of them of sufficient value to justify their transportation for a distance of 300 miles, to take their places in the cabinets of the University.

The most valuable specimen was a saurian, found in the yellow limestone by the writer. A single vertebral bone was first observed, on June 17th, upon the blue shale at the bottom of a narrow ravine. No further remains were discovered until the following day, when a systematic search was made, in company

with my assistant, Mr. L. L. Dyche. We soon detected a second bone, this time one of the phalanges, lying loosely upon the side of the ravine, several feet above the first bone and a little farther up the ravine. In a few moments more the head of a vertebra was obscurely seen in the face of the solid yellow limestone, about 8 feet from the top of the ravine. An hour's work sufficed to detach a block of rock containing several vertebræ and other bones. While removing the superfluous material from this block, in order to facilitate its removal to camp, a fortunate stroke of the hatchet revealed a peculiar reticulated surface, several square inches in extent. The thought instantly flashed upon my mind that here was something which had never before been seen by human eye. The conclusion was irresistible that the reticulated surface was the fossilized covering of the skin of the saurian, so perfectly preserved that every scale was distinctly visible, its outline clearly marked, and the elevated central line, or "carina," unmistakably indicated. Although, according to Prof. Dana's time-ratios, a period of five million years must have elapsed since this saurian swam in the shallow waters of the cretaceous seas of Western Kansas, yet each individual scale exposed to view was as perfectly preserved as if the animal had but yesterday died.

Prof. Marsh, of Yale college, some years ago described the large dermal plates, or scutes, belonging to other mosasauroid genera, which, as he writes me, "appear to be mainly confined to the neck and throat." But, so far as I am able to learn, nothing has been hitherto known of the *general* covering of the saurian body in *any* genus, and nothing whatever of the dermal covering in the genus *Liodon*. It might have been expected that this covering would be found to consist of larger plates, like those of the alligator and crocodile. On the contrary, it is composed of small scales, much resembling in size, shape and arrangement, the scales of living Ophidians. Dana, in his Manual of Geology (2d Edition, p. 465), speaks of the mosasaurs as "snake-like reptiles." This comparison is strengthened when it is found that their dermal scales were almost an exact prefiguration of those of the rattle-snakes which infest the ledges within which these saurians are found. The scales first exposed to view appeared to be on the anterior portion of the central surface of the body, but another small area was found not far from the pelvic bones. All the scales discovered were on the lower surface of the body, the bones lying above them, except in one or two spots where a bone had, by pressure, been forced through the dermal covering. The original surface exposed was afterward increased in extent, until a total continuous area of 33⅓ square inches was uncovered. This surface contained an average of 90 scales to the square inch, or a total of 3,000 scales. These are all preserved upon a single block of limestone, which also contains several vertebræ, phalanges, and other bones. A comparison with the scales of the living rattlesnake of the plains (*Crotalus confluentus* Say), indicates that the scales of the saurian were somewhat smaller than those of the snake, which, in a full grown "rattler," average 80 to the square inch, instead of 90.

On the day after the discovery of this dermal surface, I determined to obtain the remainder of the saurian, which was imbedded in the solid rock. It was



necessary to remove 8 feet of superincumbent material before the proper level or "horizon" was reached, and also to undermine the specimen, in order to secure the remains in their original position, and, if possible, to expose a larger portion of the dermal covering. After three days and a half of hard labor, by myself and two assistants, we succeeded in removing one large slab, 5½ feet by 2½ feet, and 6 inches in thickness, weighing 500 ℔., and two smaller slabs, each containing the bones of a hind leg and foot. The large slab was found to contain dorsal vertebræ, ribs, and pelvic bones, in perfect preservation, and apparently without distortion. It also contains one of the forward limbs, or hands, lying underneath the ribs and vertebræ, with the bones in natural position. In this hand there are 47 of the hour-glass shaped bones of the palm and fingers, the five series consisting respectively of 12, 11, 10, 8, and 6 bones. The terminal or 12th bone of the first series is very minute, and triangular in shape, or, more exactly, shaped like the half of an hour-glass. The accompanying wood cut represents the bones of this hand or front paddle precisely as they lie in the slab.

No attempt has yet been made to expose the dermal covering contained in the large slab, and it is exceedingly doubtful if such an attempt would prove successful. The bones imbedded in this slab, and now brought out in relief, are not in their natural position, except those of the hand above mentioned. Only two of the twenty vertebræ, which are scattered over the slab in all positions, remain united. The dozen ribs are variously disposed, and one of the thigh bones occupies a spot not far from the center of the lower margin of the slab. The appearance is very much as if some more powerful saurian or shark had devoured the flesh upon the larger bones of the victim, leaving untouched a portion of the skin of the lower surface of the body and one of the front paddles, which proba-

bly did not contain much material for the gratification of his appetite.

In regard to the generic determination of this saurian, I can only say, that of the three well marked genera of the mosasauroid reptiles of the Kansas cretaceous, the specimen seems to agree most accurately with *Liodon* Owen (*Tylosaurus* Marsh). This genus is indicated by the broad neural spines, and by the fact that the number of bones in the first digit of the paddles is the greatest. The specific determination given in the title of this paper will probably be found to be correct. The specimen appears to be a small-sized individual of its species.

The following measurements are appended:

	M.
Dermal scale—	
Length	.0033
Breadth	.0025
Length of "carina,"	.0037
Dorsal vertebra—	
Length of centrum	.075
" neural spine	.095
Breadth of neural spine, at base	.074
" " " at tip	.039
Vertical diameter of cup	.058
Transverse diameter of cup	.000
Longest rib—	
Tip to tip	.381
Along curvature	.418
Breadth at base	.025
" tip	.009
" center	.012
Femur—	
Length	.132
Breadth at proximal end	.082
" distal end	.073
" center	.050
Front paddle, total length	.726
Coracoid—	
Length	.118
Breadth at proximal end	.131
Curvature at proximal end	.195
Breadth at distal end	.056
Distance of perforation from outer edge	.026
" " inner edge	.042
Humerus—	
Length	·122
Breadth at proximal end	·074
" distal end	·080
Ulna—	
Length	.093
Breadth proximal	.041
" distal	.063
Radius—	
Length	.094
Breadth proximal	.047
Breadth distal	.041

ARCHÆOLOGY.

PERUVIAN ANTIQUITIES.

BY E. R. HEATH, M. D., WYANDOTTE, KAS.

On the Peruvian coast in ancient times, as now, nearly every structure was made of adobes or sun-dried brick, while in the mountains stone was used instead. The adobe ruins present nothing of beauty, architecturally. The subject for wonder is their immensity and number. Go where you will, relics of the past meet your eye either in ruined walls, water-courses, terraces, or extensive lands covered with the debris of pottery.

Take for example the Jequetepeque valley. In 7° 24′ south latitude you will find on recent maps the port of Pacasmayo. Four miles north, separated from it by a barren waste, the river Jequetepeque empties into the sea. The bottom lands of the river are from two to three miles in width, with a southern sloping bank and the northern a perpendicular one nearly eighty feet high. Beside the southern shore, as it empties into the sea, is an elevated plat one-fourth of a mile square and forty feet high, all of adobes. A wall fifty feet wide connects it with another, a few hundred yards east and south, that is 150 feet high, 200 feet across the top, and 500 at the base, nearly square. This latter was built in sections of rooms ten feet square at the base, six feet at the top and about eight feet high. These rooms were afterward filled with adobes, then plastered on the outside with mud and washed in colors. All of this same class of mounds—temples, to worship the sun, or fortresses, as they may be—have on the north side an incline for an entrance or means of access. Treasure-seekers have cut into this one about half way, and it is said $150,000 worth of gold and silver ornaments were found. In the sand, banked up behind the wall and mound, many were buried, as the thousands of skulls and bones now exposed prove; thrown out by the hunter of huacos, as the pottery is called, huaca being the name given to these cemeteries. Each body has buried with it a vessel or water craft and a pot with grains of corn or wheat, and it is supposed the drinking vessel was filled with "chicha," a fermented drink made from corn or pea-nuts. Beside these were many ornaments of gold, silver, copper, coral and shell beads and cloths. On the north side of the river, on the top of the bluff, are the extensive ruins of a walled city, two miles wide by six long. Within the enclosure are the relics of two large reservoirs for fresh water. The clay from which these adobes were made was found at least six miles distant.

Follow the river to the mountains. All along you pass ruin after ruin and huaca after huaca. At Tolon, a town at the base of the mountains, the valley is crossed by walls of boulders and cobble stones, ten, eight and six feet high, one foot to eighteen inches wide at the top and two to three feet at the base, enclos-

ing ruins of a city one-fourth of a mile wide and more than a mile long. The upper wall has projecting parts at the entrances, with port-holes, evidently serving as sentry boxes. At this point the Pacasmayo Railroad enters the Jequetepeque valley. For eight miles back it crosses a barren sand plain of more than fifteen miles in length, covered with ruined walls, water courses, dead algaroba and espino trees, with fragments of pottery and sea shells, even to nine feet in depth mixed with the sand. The base of the mountains have, in good state of preservation, many thousand feet of an old water course, while their sides to the perpendicular parts are lined with terraces. This water course took its head from a ravine now dry, and, even beyond the memory of the oldest inhabitants, except in one or two cases, never carried water. It can be traced as far as Ascope, forty-five miles south. Five miles from Tolon, up the river, there is an isolated boulder of granite, four and six feet in its diameters, covered with hieroglyphics. Fourteen miles further, a point of mountain at the junction of two ravines is covered to a height of more than fifty feet with the same class of hieroglyphics: Birds, fishes, snakes, cats, monkeys, men, sun, moon and many odd and now unintelligible forms. The rock on which these are cut is a silicated sandstone, and many of the lines are an eighth of an inch deep. In one large stone there are three holes, twenty to thirty inches deep, six inches in diameter at the orifice and two at the apex, and although polished as porcelain, these markings extend even to the bottom. The locality is of no importance; the stones as nature placed them; why, then, was so much labor and time expended upon them?

At Anchi, on the Rimac river, upon the face of a perpendicular wall two hundred feet above the river bed, there are two hieroglyphics, representing an imperfect B and a perfect D. In a crevice below them, near the river, were found buried twenty-five thousand dollars worth of gold and silver. When the Incas learned of the murder of their chief, what did they do with the gold they were bringing for his ransom? Rumor says they buried it, and many places are pointed out and thousands of dollars spent in useless search for the lost treasure. May not these markings at Yonan tell something, since they are on the road and near to the Incal city? Eleven miles beyond Yonan, on a ridge of mountain seven hundred feet above the river, are the walls of a city of 2,000 inhabitants. A perilous ascent on hands and knees is now the only way to reach it; however, on the opposite side of the river are similar ruins, but easy of access. A remnant of a stone wall, ten and twelve feet high, built of small flat stones and without mortar, probably at one time served as river protection and against the tribe on the other side, there being a tradition that two powerful chiefs occupied these cities and were ever at war. The dead were buried in sepulchres, using large boulders as the top, while stone walls divided the space beneath into compartments. Six and twelve miles further are extensive walls and terraces. Three miles north of the latter place are the rich silver mines of Chilete, formerly worked by the Indians, who left excavations two and three

hundred feet deep, and must have taken out quantities of silver. A company with a paid-up capital of half a million is now working them.

Leaving the valley at seventy-eight miles from the coast, you zigzag up the mountain side 7,000 feet, then descend 2,000, to arrive at Cajamarca, or Coxamalca of Pizarro's time. Here and there all the way you find relics of the past. In a yard off one of the main streets, and near the center of the city, is still standing the house made famous as the prison of Atahualpa, and which he promised to fill with gold as high as he could reach, in exchange for his liberty. Like all their stone work, the walls are slightly inclined inward, uncemented, built of irregular stones, each exactly faced to fit the next. The floor and porch are cut out of the solid stone, two and three feet deep, as the still intact remnants of stone pillars of the same rock show. The hill from which the stone for the walls was taken is near by. On its top a large stone in the shape of a chair bears the name of "Inca's chair," and the Indians say it was the king's custom to sit here every morning and salute the sun as it rose above the horizon. The two large places excavated out of the rock on the hillside, and now used as reservoirs for the city, were of ancient make. Three miles distant, and across the valley, are the hot springs, where the Inca was encamped when Pizarro took possession of Cajamarca. Part of the wall is of unknown make, (that encloses the baths.) Cemented, the cement is harder than the stone itself. At Chocofan, nine miles from Pascamayo, on the line of the railroad, a barren, rocky mountain, 1,200 feet high, is encircled four hundred feet from its top by a stone wall eight or ten feet high. From its northern side, running nearly northwest, is about five miles of the coast road of the Incas. Perfectly straight, it is twenty feet wide, and walled on both sides by round stones piled to a height of three and four feet, three feet wide at the base and two at the top, uncemented. At Chepen, a station near the terminus of the branch of the Pacasmayo Railroad, is a mountain with a wall in many places twenty feet high, the summit being almost entirely artificial. In the sand at its base is one of Peru's most extensive "huacas," and from which some of the finest pottery and ornaments have been taken.

Fifty miles south of Pacasmayo, between the seaport of Huanchaco and Truxillo, nine miles distant, are the ruins of "Chan Chan," the capital city of the Chimoa kingdom, which extended, when conquered by the Incas, from Supe to Tumbez, or over nearly the northern half of the coast of modern Peru. The road from the port to the city crosses these ruins, entering by a causeway about four feet from the ground, and leading from one great mass of ruins to another; beneath this is a tunnel. Be they forts, castles, palaces, or burial mounds called "huacas," all bear the name "huaca." Hours of wandering on horseback among these ruins give only a confused idea of them, nor can old explorers there point out what were palaces and what were not.

To the right is the "Huaca of Toledo;" to the left, "Bishop's Huaca." The large square enclosures, shut in by wedge-shaped walls of adobe, twenty to twenty-five feet high, have nothing of an entrance into them that would be defined as a palace gate. A half a dozen of these, at least, are among the ruins. Within

some of them are large square mounds or burying chambers, many of which have been opened and rifled of their contents. These are plastered at the ceilings. Beside the so-called "huacas" already mentioned, there is another on the left side of the road called by the Spaniards "the Mass." On many of the walls is some excellent stucco work. Excellent as regards the material of which it is made, more than with reference to its style of art. There is not a single grain of disintegration in the parts that surround the walls of the chamber, although it is half an inch high above the ordinary plaster in which it is done, nor the slightest impairment in its integrity during the many centuries it has stood exposed to the elements. The highest enclosures—those of adobe brick, up to thirty feet, with a base of fiteen feet, on the right hand of the city as you advance toward Truxillo, between that town and the "Toledo huaca"—must have cost an immense amount of labor, and needed a large number of hands for their erection. Inside some of them, besides the square mounds, are narrow passages, not more than a yard in width. In others are squares, wherein are visible, though now filled with clay, the outlines of water tracks. On this side are the principal burial mounds, some having stairs of adobe.

In the city of Truxillo there exists in the records of the municipality a copy of the accounts that are found in the book of Fifths of the Treasury, in the years 1577 and 1578, referring to the "Huaca of Toledo." The following is a condensed inventory :

First.—In Truxillo, Peru, on the 22d of July, 1577, Don Garcia Gutierrez de Toledo presented himself at the royal treasury, to give into the royal chest a fifth. He brought a bar of gold nineteen carats ley and weighing two thousand four hundred Spanish dollars, of which the fifth, being seven hundred and eight dollars, together with one and a half per cent. to the chief assayer, were deposited in the royal box.

Second.—On the 12th of December he presented himself with five bars of gold, fifteen and nineteen carats ley, weighing eight thousand nine hundred and eighteen dollars.

Third.—On the 7th of January, 1578, he came with his fifth of large bars and plates of gold, one hundred and fifteen in number, fifteen to twenty carats ley, weighing one hundred and fifty-three thousand, two hundred and eighty dollars.

Fourth.—On the 8th of March he brought sixteen bars of gold, fourteen to twenty-one carats ley, weighing twenty-one thousand one hundred and eighteen dollars.

Fifth.—On the 5th of April he brought different ornaments of gold, being little bells of gold and patterns of corn-heads and other things, of fourteen carats ley, weighing six thousand two hundred and seventy-two dollars.

Sixth.—On the 20th of April he brought three small bars of gold, twenty carats ley, weighing four thousand one hundred and seventy dollars.

Seventh.—On the 12th of July he came with forty-seven bars, fourteen to twenty-one carats ley, weighing seventy-seven thousand, three hundred and twelve dollars.

Eighth.—On the same day he came back with another portion of gold and ornaments of cornheads and pieces of effigies of animals, weighing four thousand seven hundred and four dollars.

The sum of these eight bringings amounted to 278,174 gold dollars or Spanish ounces. Multiplied by sixteen gives $4,450,784 silver dollars. Deducting the royal fifth—$985,953.75—left $3,464,830.25 as Toledo's portion.

Even after this great haul, effigies of different animals of gold were found from time to time. Mantles also, adorned with square pieces of gold, as well as robes made with feathers of divers colors, were dug up. There is a tradition that in the huaca of Toledo there were two treasures, known as the great and little fish. The smaller only has been found.

Between Huacho and Supe, the latter being one hundred and twenty miles north of Callao, near a point called Atahuanqui, there are two enormous mounds, resembling the Campana and San Miguel, of the Huatica valley, soon to be described. About five miles from Patavilca (south and near Supe) is a place called "Paramonga," or the fortress. The ruins of a fortress of great extent are here visible; the walls are of tempered clay, about six feet thick. The principal building stood on an eminence, but the walls were continued to the foot of it, like regular circumvallations; the ascent winding round the hill like a labyrinth, having many angles, which probably served as outworks to defend the place. In this neighborhood much treasure has been excavated, all of which must have have been concealed by the pre-historic Indian, as we have no evidence of the Incas ever having occupied this part of Peru after they had subdued it.

From Lima north along the coast the Ancon & Chancay Railroad is built. Ancon, eighteen miles from Lima, is a favorite summer seaside resort. Just before reaching Ancon, the railroad runs through an immense burying-ground or "huaca." Make a circuit of six to eight miles, and on every side you see skulls, legs, arms, and the whole skeleton of the human body, lying about in the sand. Legs attached to pelvis, and bent up, still with mummified skin on them; arms in the same state; relics of plaited straw, forming coffin swathes; pieces of net, of cloth, and many other such accompaniments of funeral accessories. Some water crafts of very superior quality have been obtained from these graves. Of these there are three different forms, in places separated a short distance from each other, but each style having its defined outline of *locale*. As to the shape of the graves, there are some of an inverted cylinder form, like that of a lime-kiln, the insides of which are lined with masonry work. In these the body is placed in the upright position. There is also the ordinary longitudinal grave, in which the corpse is right in contact with the earth. Likewise the grave cut square to a depth of six to eight feet, at the top of which, or within one or two feet of the surface of the ground, is a roofing or covering of mat work, placed on wooden rafters. In one of these Dr. Hutchinson, her Britannic Majesty's Consul at Callao, found three bodies, all wrapped up together—being a man, woman and child—their faces being swathed with llama wool instead of cotton, as is usually seen in ordinary ones. He also turned out relics of fishing nets, with some

needles for making them, varieties of cloth, tapestry, and work-bags resembling ladies' reticules. Not a vestige of vegetation about, nor sign of relic of the terraces mentioned by Prescott. Whence came these hundreds and thousands of people who are buried at Ancon? How did they make out a living while on the earth? Time and time again the archæologist finds himself face to face with such questions, to which he can only shrug his shoulders and say with the natives, "Quien sabe?" Who knows?

At Pasamayo, 14 miles further "down north," and on the sea shore, is another great burying ground. Thousands of skeletons lie about, thrown out by the treasure-seekers. It has more than a half mile of cutting through it for the Ancon & Chancay R. R. It extends up the face of the hill from the sea-shore to the height of about 800 feet, and being from a half to three-fourths of a mile in breadth, some idea may be formed of its extent.

Dr. Hutchinson, in two days, from these burial grounds, gathered 384 skulls, which, with specimens of pottery, he presented to Professor Agassiz and he to the Cambridge University, near Boston.

Between the teeth he found pieces of copper as if for the Charon obolus, and one or two had plates of copper on their heads.

Crossing the brow of the hill, entering Chancay, and stretching toward the sea, are the remains of a six feet adobe wall. On the face of this hill, pointing to the line of the railway from Ancon, are two stone ditches, perfectly parallel and symmetrical, about 100 yards apart, and running from bottom to top to a height of about 300 yards. Between these are other lines of stone displaced, perhaps the ruins of some old terraces. All about this place, at the base of the hill, looking towards Chancay, as well as on the side in front of the sea, is full of graves; some are built up with stone walls, others lined inside with mud-bricks, of no formation more than a heap of clay and water moulded up in the hands and dried in the sun. Over the hills of Chancay are quantities of small stones of different geological formation from the rock there.

Dr. Hutchinson writes, under date of Oct. 30th, 1872, in an article to the Callao and Lima *Gazette*, now the South Pacific *Times*: "I am come to the conclusion that Chancay is a great city of the dead, or has been an immense ossuary of Peru; for go where you will, on mountain top or level plain, or by the sea side, you meet at every turn, skulls and bones of all descriptions."

Lima, the capital of Peru, is situated seven miles inland from Callao. Nine miles on the sea shore "up south," is the city of Chorillos, the Long Branch of Peru. A railway connects Lima with these two cities, forming with the coast nearly a right angled triangle. This triangular ground is known as the Huatica Valley, and is an extensive ruin. Between Callao and Magdalena, four miles distant, there are seventeen mounds called "huacas," although they present more the form of fortressess, residences or castles, than burying grounds. 'Tis difficult to make out anything but fragments of walls, as the ground is mostly under cultivation. However, at various points, one can see that a triple wall surrounded the ancient city. These walls are respectively one yard, two yards, and

three yards in thickness, being in some parts of their relics, from fifteen to twenty feet high. To the east of these is the enormous mound called Huaca of Pando; and to the west, with the distance of about half a mile intervening, are the great ruins of fortresses, which natives entitle Huaca of the Bell. La Campana, the huacas of Pando, consisting of a series of large and small mounds, and extending over a stretch of ground incalculable without being measured, form a colossal accumulation. The principal large ones are three in number; that holding the name of the "Bell" is calculated to be 108 to 110 feet in height. At the western side, looking towards Callao, there is a square plateau with an elevation of about twenty-two to twenty-four feet, 95 to 96 yards north and south, east and west. At the summit it is 276 to 278 yards long, and 95 to 96 across. On the top there are eight gradations of declivity, each from one to two yards lower than its neighbor; counting in direction lengthwise, the 1st plateau is 96 to 97 yards; 2nd plateau, 96 to 26 yards; 3rd plateau, 23 to 24 yards; 4th plateau, 11 to 12 yards; 5th plateau, 11 to 25 yards; 6th plateau, 23 to 24 yards; 7th plateau, 35 to 36 yards; 8th plateau, 35 to 37 yards; making the total of about 278 yards. For these measurements of the Huatica ruins I am indebted to the notes of J. B. Steere, Professor of Natural History and Curator of the Museum at Ann Arbor, Michigan.

The square plateau first mentioned, at the base, consists of two divisions, one six feet lower than the other, but each measuring a perfect square 47 to 48 yards; the two joining form the square of 96 yards. Beside this, and a little forward on the western side, is another square 47 to 48 yards. On the top, returning again, we find the same symmetry of measurement in the multiples of twelve, nearly all the ruins in this valley being the same, which is a fact for the curious. Was it by accident or design? In its breadth from north to south, three levels are found. The first lower down, 17 to 18 yards wide; the second or highest summit, 59 to 60 yards across; and the third descent again, 23 to 24 yards. The mound is a truncated pyramidal form, and is calculated to contain a mass of 14,641,820 cubic feet of material. For the most part, this great work is composed of adobes, each six inches long, four inches wide, and two and a half inches thick, many having the marks of fingers on them. But this does not consist of more than one-third of the Pando huaca.

Walking down past the southern corner, where the adobes are tumbled into a conglomerate mass by some earthquake, we see skulls with bones of arms and legs, cropping up in many places. The same adobe work is visible throughout, and the whole length of these structures ranges between seven and eight hundred yards. The "Fortress" is a huge structure, 80 feet high, 148 to 150 yards in measurement. Great large square rooms show their outlines on the top, but are filled with earth. Who brought this earth here, and with what object was the filling up accomplished? The work of obliterating all space in these rooms with loose earth must have been almost as great as the construction of the building itself. About two miles south of the last named large fort, and in a parallel line with it as regards the sea, we find another similar structure, probably a little

more spacious and with a greater number of apartments, or divisions by walls, on the top of which we can now walk, as it is likewise filled up with clay. This is called "San Miguel." It is nearly 170 yards in length, and 168 in breadth, and 98 feet high. The whole of these ruins, big fortress, small forts and temples, were enclosed by high walls of adobones, but all of wedge-shaped form, with the sharp edge upward. Adobones are large mud bricks, some from one to two yards in thickness, length and breadth. The huaca of the "Bell" contains about 20,220,840 cubic feet of material, while that of "San Miguel" has 25,-650,800. These two buildings were constructed in the same style—having traces of terraces, parapets, and bastions, with a large number of rooms and squares—all now filled up with earth.

Near Lima, on the south, is another mound, 70 feet high and 153 yards square. Near the residence of Par Soldan, the Geographer of Peru, is a mound called "Sugar Loaf," or "San Isidro," 66 feet high, 80 yards broad at the base, and 130 yards long. Professor Raimondi, the naturalist, chemist and scientist, who is doing for Peru what Gay did for Chili, said he found nothing in it but bodies of ordinary fishermen, relics of nets, and some inferior specimens of pottery.

Prof. Steere and Dr. Hutchinson turned out about forty skulls, some bits of red and yellow dyed thread, being relics of cloth; a piece of string made of woman's hair, plaited, about the size of what is generally used for a watch guard; and pieces of very thick cotton cloth, bits of fish nets, portions of slings, and two specimens of crockery ware of excellent material.

About a mile beyond, in the direction of "Mira Flores," is Ocharan, the largest burial mound in the Huatica valley. This mound presents, as it is approached, the appearance of an imposing and enormous structure. It has 95 feet of elevation in its highest part, with an average width of 55 yards on the summit and a total length of 428 yards, or 1,284 feet, another multiple of twelve. It is inclosed by a double wall 816 yards in length by 700 across, thus enclosing 117 acres. Between Ocharan and the ocean are from 15 to 20 masses of ruins, like those already described.

Fifteen miles south of Lima in the valley of Lurin, and near the sea, are the ruins of Pacha Camac, the Inca temple of the sun. Like the temple of Cholula on the plains of Mexico, it is a sort of made mountain or vast terraced pyramid of earth. It is between two and three hundred feet high, and forms a semi-lunar shape, that is beyond a half mile in extent. Its top measures about ten acres square. Much of the walls are washed over with a red paint, probably ochre, and are as fresh and bright as when centuries ago it was first put on. In these walls in three or four places, are niches, apparently of the same shape and size as we see in the ruins of Pagan temples. From one side, going toward the north, are the relics of a wall, which is covered with soot, possibly the remnant of fires to make sacrifices, and nothing can better illustrate the conservative tendency of the Peruvian climate than the fresh appearance of the soot. Prescott says of Pacha Camac, that it was to the Peruvians what Mecca is to the Mahometan, and Cholula was to the Mexican.

In the Canete valley, opposite the Chincha Guano Islands, are extensive ruins. In that region a terra-cotta mask was found, similar to that of which there is a drawing in Mr. Squiers' report of his explorations in the State of New York, and discovered while excavating for the St. Lawrence canal. From the hill called "Hill of Gold," copper and silver pins were taken like those used by ladies to pin their shawls; also, tweezers for pulling out the hair of the eye-brows, eye-lids and whiskers, as well as silver cups.

Buried 62 feet under the ground on the Chincha Islands, stone idols and water pots were found, while 35 and 33 feet below the surface were wooden idols. Beneath the Guano on the Guañapi Islands, just south of Truxillo, and Macabi just north, mummies, birds and bird's eggs, gold and silver ornaments were taken. On the Macabi the laborers found some large valuable golden vases, which they broke up and divided among themselves, even though offered weight for weight in gold coin, and thus have relics of greatest interest to the scientist been forever lost. He who can determine the centuries necessary to deposit thirty and sixty feet of guano on these islands, remembering that, since the conquest three hundred years ago, no appreciable increase in depth has been noted, can give you an idea of the antiquity of these relics.

The coast of Peru extends from Tumbez on the north to the river Loa on the south, a distance of 1,235 miles. Scattered here and there over this whole extent, there are thousands of ruins beside those just mentioned, and similar, only not so extensive; while nearly every hill and spur of the mountains have upon them or about them some relic of the past; and in every ravine from the coast to the central plateau, there are ruins of walls, fortresses, cities, burial vaults, and miles and miles of terraces and water courses. Across the plateau and down the eastern slope of the Andes to the home of the wild Indian, and into the unknown, impenetrable forest, still you find them. In 1861, Mendoza, in the Argentine Republic, a beautiful city on the plain, 45 miles from the foot of the Andes, in the short space of five minutes was a complete ruin, and 15,000 out of her 20,000 inhabitants, or 75 per cent., were in the arms of death. In 1871 it was still exactly as on the evening of her destruction; the miles of skeletons lying uncovered where they perished, and the streets yet obstructed with the debris of the fallen walls of the houses. A new city has been built beside the old one. Seeking a photograph of the ruins, I was told there were none. Persuading one of the artists to take some views of them, and going to see the proof, he told me he had been out all day and had done nothing, as he could find nothing to take "but a pile of dirt." Thus, also, you might, as most do, style these coast ruins, and those who live among them understand and appreciate them no better than did the Mendoza artist the ruins of that ill-fated city.

In the mountains, however, where storms of rain and snow with terrific thunder and lightning are nearly constant a number of months each year, the ruins are different. Of granitic, porphyritic, lime and silicated sand-stone, these massive, colossal, cyclopean structures have resisted the disintegration of time, geological transformations, earthquakes, and the sacrilegious, destructive hand of

the warrior and treasure-seeker. The masonry composing these walls, temples, houses, towers, fortresses, or sepulchres, is uncemented, held in place by the incline of the walls from the perpendicular, and adaptation of each stone to the place destined for it, the stones having from six to many sides, each dressed, and smoothed to fit another or others, with such exactness that the blade of a small pen knife cannot be inserted in any of the seams thus formed, whether in the central parts entirely hidden, or on the internal or external surfaces. These stones, selected with no reference to uniformity in shape or size, vary from one-half cubic foot to 1,500 cubic feet solid contents, and if, in the *many*, *many millions* of stones you could find *one* that would fit in the place of another, it would be purely accidental. In "Triumph street," in the city of Cuzco, in a part of the wall of the ancient house of the virgins of the sun, is a very large stone, known as "the stone of the twelve corners," since it joins with those that surround it, by twelve faces, each having a different angle. Beside these twelve faces it has its external one, and no one knows how many it has on its back that is hidden in the masonry. In the wall of the center of the Cuzco fortress there are stones 13 feet high, 15 feet long, and eight feet thick, and all having been quarried miles away. Near this city there is an oblong smooth boulder 18 feet in its longer axis, and 12 in its lesser. On one side are large niches cut out, in which a man can stand, and by swaying his body cause the stone to rock. These niches apparently were made solely for this purpose. One of the most wonderful and extensive of these works in stone, is that called Ollantay-Tambo, a ruin situated thirty miles north of Cuzco, in a narrow ravine on the bank of the river Urubamba. It consists of a fortress constructed on the top of a sloping, craggy eminence. Extending from it to the plain below, is a stone stairway. At the top of the stairway are six large slabs, twelve feet high, five feet wide, and three feet thick, side by side, having between them and on top narrow strips of stone about six inches wide, frames as it were to the slabs, and all being of dressed stone. At the bottom of the hill, part of which was made by hand, and at the foot of the stairs, a stone wall ten feet wide and twelve feet high extends some distance into the plain. In it are many niches, all facing the south.

The ruins on the islands in Lake Titicaca, where Incal history begins, have often been described.

At Tiahuanaco, a few miles south of the lake, there are stones in the form of columns, partly dressed, placed in line at certain distances from each other, and having an elevation above the ground of from eighteen to twenty feet. In this same line there is a monolithic doorway, now broken, ten feet high by thirteen wide. The space cut out for the door is seven feet four inches high, by three feet two inches wide. The whole face of the stone above the door is engraved. Another, similar, but smaller, lies on the ground beside it. These stones are of hard porphyry, and differ geologically from the surrounding rock, hence, we infer they must have been brought from elsewhere.

At "Chavin de Huanta," a town in the province of Huari, there are some ruins worthy of note. The entrance to them is by an alley-way six feet wide and

nine feet high, roofed over with sand-stone partly dressed, of more than twelve feet in length. On each side there are rooms twelve feet wide, roofed by large pieces of sand-stone one and a half feet thick and from six to nine feet wide. The walls of the rooms are six feet thick, and have some loop-holes in them, probably for ventilation. In the floor of this passage there is a very narrow entrance to a subterranean passage that passes beneath the river to the other side. From this many huacos, stone drinking vessels, instruments of copper and silver, and a skeleton of an Indian sitting, were taken. The greater part of these ruins are situated over aqueducts. The bridge to these castles is made of three stones of dressed granite, twenty-four feet long, two feet wide by one and a half thick. Some of the granite stones are covered with hieroglyphics.

At Corralones, twenty-four miles from Arequipa, there are hieroglyphics engraved on masses of granite, which appear as if painted with chalk. There are figures of men, llamas, circles, parallelograms, letters, as an R and an O and even remains of a system of astronomy.

At Huaytar, in the Province of Castro Virreina, there is an edifice with the same engravings.

At Nazca, in the Province of Ica, there are some wonderful ruins of aqueducts, four to five feet high and three feet wide, very straight, double walled, of unfinished stone, flagged on top.

At Quelap, not far from Chochapayas, there have lately been examined some extensive works. A wall of dressed stone 560 feet wide, 3,660 long, and 150 feet high. The lower part is solid. Another wall above this has 600 feet length, 500 width, and the same elevation of 150 feet. There are niches over both walls, three feet long, one and a half wide and thick, containing the remains of those ancient inhabitants, some naked, others enveloped in shawls of cotton of distinct colors, and well embroidered. Their legs were doubled so that the knees touched the chin, and the arms were wound about the legs. The wall has three uncovered doors, the right side of each being semicircular, and the left angular. From the base an inclined plane ascends almost insensibly the 150 feet of elevation, having about mid-way a species of sentry box in stone. In the upper part there is an ingenious hiding place of dressed stone, having upon it a place for an outlook from which a great portion of the Province can be seen. Following the entrances of the second and highest wall, there are other sepulchres like small ovens, six feet high and twenty-four in circumference, in their base are flags, upon which some cadavers reposed. On the north side there is, on the perpendicular rocky side of the mountain, a brick wall, having small windows 600 feet from the bottom. No reason for this, nor means of approach, can now be found. The skillful construction of utensils of gold and silver that were found here, the ingenuity and solidity of this gigantic work of dressed stone, make it, also, probably of pre-Incal date.

To support the inhabitants, it became necessary to cultivate every part of the land possible, and since the greater portion is mountainous, they could make no use of that land except by such means as they adopted, i. e., by terraces.

Along the side, at the base of a hill or mountain, a stone wall is laid from one to eight feet high, according to the slope, and earth filled in between it and the side of the mountain, till even with the wall. Having this level for a base, another wall is laid, and again earth filled in, and so on, tier above tier, as high as the place will permit. These are terraces. The summits of the mountains are saturated with water from the melting snow or winter rains. This, forming little streams, is guided over these terraces. Each terrace is divided into patches by making a little ridge of earth a few inches high all around them, enclosing places two feet by six, or eight feet by ten, and so on according to the size of the terrace. The top terrace is first flooded, the ridge of earth serving as a dam. When it is considered wet enough, a channel is made by taking out a part of the ridge (with the hand or a little paddle about the size of a pancake turner) permitting the water to escape to the part below, flowing over the wall to the next terrace, which is similarly treated. But there are thousands of terraces where the mountains and hills are so low and near the rainless portion that snow never, and rain very seldom, moistens their summits, and where no one could expect water for irrigation unless carried there by hand. Starvation alone would compel people to undertake so fatiguing and laborious a work, especially in a country where the evenness of the climate tends to relax the energy of both mind and body. Estimating five hundred ravines in the twelve hundred miles of Peru, and ten miles of terraces of fifty tiers to each ravine, which would only be five miles of twenty-five tiers to each side, we have 250,000 miles of stone wall, averaging three to four feet high—enough to encircle this globe ten times. Surprising as these estimates may seem, I am fully convinced that an actual measurement would more than double them, for these ravines vary from thirty to one hundred miles in length, and ten miles to each is a low estimate. While at San Mateo, a town in the valley of the river Rimac, seventy-seven miles from the coast, where the mountains rise to a height of fifteen hundred or two thousand feet above the river bed, I counted two hundred tiers, none of which were less than four and many more than six miles long. Even at four miles, there would be at that point alone eight hundred miles of stone wall, and that only on one side of the ravine.

Who, then, were these people, cutting through sixty miles of granite, transporting blocks of hard porphyry, of Baalbic dimensions, miles from the place where quarried, across valleys thousands of feet deep, over mountains, along plains, leaving no trace of how or where they carried them; people ignorant of the use of iron, with the feeble llama their only beast of burden; who, after having brought these stones together and dressed them, fitted them into walls with mosaic precision; terracing thousands of miles of mountain side; building hills of adobes and earth, and huge cities; leaving works in clay, stone, copper, silver, gold and embroidery, many of which cannot be duplicated at the present age; people apparently vying with Dives in riches, Hercules in strength and energy and the ant and bee in industry?

Callao was submerged in 1746 and entirely destroyed. Lima was ruined in 1678—in 1746 only twenty houses out of three thousand were left standing—and

again injured in 1764, 1822 and 1828, while the ancient cities in the Huatica and Lurin valleys still remain in a comparatively good state of preservation. San Miguel de Piura, founded by Pizarro in 1531, was entirely destroyed in 1855, while the old ruins near by suffered little. Arequipa was thrown down in August, 1868, but the ruins near show no change.

Spanish writers refer all to Incal make, but Incal history only dates back to the eleventh century, and from that time to the Conquest is insufficient, nor do they speak of many of these works. It is granted that the Temple of the Sun, at Cuzco, was of Incal make, but that is the latest of the five styles of architecture visible in the Andes, each probably representing an age of human progress; therefore we are pretty certain that the imperial glories of the Incas were but the last gleam of civilization that mounted up to thousands of years; that long before Manco Capac, the Andes had been the dwelling place of races whose beginnings must have been coeval with the savages of Western Europe. The gigantic architecture points to the Cyclopean family, the founders of the Temple of Babel and the Egyptian Pyramids. The Grecian scroll found in many places, borrowed from the Egyptians; the mode of burial and embalming their dead, points to Egypt as their similar, while the distaff, plow, manner of threshing and of making brick, are the same as when the Israelites were captives.

The hieroglyphics, to none of which as yet a key has been found, cannot be referred to the Incas, since they apparently had no knowledge of characters, but kept their records and accounts by means of a quippus, or knots and different colored threads, as did those in Asia, China, Mexico and Canada, in ancient times, and they kept in each city an official whose business it was to keep and decipher their quippus. It was made of twisted wool, and consisted of a thread or thick string, from one to eighteen feet long, as a base upon which other threads or strings were attached. The different colors had different significations: the red, soldier or warrior; the yellow, gold; the white, silver or peace; the green, wheat or corn, and so on. In numerals, one knot signified ten; two simple knots, twenty; the knot doubly interlaced, one hundred; trebly interlaced, one thousand; two interlacings of this latter, two thousand. By setting apart a quippus for the military, another for laws and decrees, another for historic events —i. e., a separate quippus for distinct classes of ideas—the same knots could be used many times over, but to read them one must know to which class they belonged. Certain signs were affixed to the beginning of each "mother-thread," as the base or principal string was called, by which the official could distinguish each; however, should an official visit another locality, these signs had to be explained verbally, also the signs representing local events, names of rivers, mountains, ships, cities, etc. Hence, a quippus was only intelligible, for the most part, in the place it was kept. Many quippus have been taken from the graves, in excellent state of preservation in color and texture, but the lips that alone could pronounce the verbal key, have forever ceased their function, and the relic seeker has failed to note the exact spot each was found, so that the records which could tell so much we want to know, will remain sealed till all is revealed at the last day.

The skulls taken from the burial-grounds, according to craniologists, represent three distinct races.

The first, to which the name "Chinchas" has been given, occupied the western part of Peru from the Andes to the Pacific, and from Tunebez on the north to the desert of Atacama on the south.

The second, called "Aymaras," dwelt in the elevated plains of Peru and Bolivia, on the southern shore of lake Titicaca, where they reside even to this day, being the only race that did not give up their language for the Inichua, or language of the Incas, when conquered by them.

The third, called "Huancas," occupied the plateau between the chains of Andes north of lake Titicaca to the 9th degree of south latitude. This race were supposed to have caused the peculiar shape of their heads by mechanical means, as the Flat head Indians with us, and the Conibos, a tribe that now live on the banks of the Ucayali near Sarayacu, but the taking from a mummy of a fœtus of seven or eight months having the same configuration of the skull, has placed a doubt as to the certainty of this fact.

How changed! How fallen from their greatness must have been the Incas when a little band of 160 men could penetrate uninjured to their mountain homes, murder their worshiped kings and thousands of their warriors, and carry away their riches, and that, too, in a country where a few men with stones could resist successfully an army! Who could recognize in the present Inichua and Aymara Indians their noble ancestry?

Their songs are typical of their condition, and are called "tristes," or sad songs. Always a duet in a minor key, and at night as you hear it, it seems rather the expiring wail of some lost spirit than a human voice. It begins with a full inspiration of the lungs and at the highest pitch of the voice, and ends with the expiration of the breath in a low, long drawn out "andante pianissimo." The words are chanted and often made up for the occasion. These are the words heard by a traveler from the lips of a young Indian mother, in the wild recesses of the Andes:

> "My mother begat me amid rain and mist,
> To weep like the rain and be drifted like the clouds.
> You are born in the cradle of sorrow,
> Says my mother; and she weeps as she wraps me around.
> If I wander the wide world over,
> I could not meet my equal in misery.
> Accursed be the day of my birth,
> Accursed be the night I was born,
> From this time, for ever and ever!"

Three times the Andes sank hundreds of feet beneath the ocean level, and again were slowly brought to their present height. A man's life would be too short to count even the centuries consumed in this operation. The coast of Peru has risen eighty feet since it felt the tread of Pizarro. Supposing the Andes to have risen uniformly and without interruption, seventy thousand years must have elapsed before they reached their present altitude.

Who knows, then, but that Jules Verne's fanciful idea regarding the lost continent Atlanta may be near the truth? Who can say, that where now is the Atlantic ocean, formerly did not exist a continent, with its dense population, advanced in the arts and sciences, who, as they found their land sinking beneath the waters, retired, part east and part west, populating thus the two new hemispheres? This would explain the similarity of their archæological structures and races and their differences, modified by and adapted to the character of their respective climates and countries. Thus could the llama and camel differ, although of the same species; thus the algoraba and espino trees; thus the Iroquois Indians of North America and the most ancient Arabs call the constellation of the "Great Bear" by the same name; thus various nations, cut off from all intercourse or knowledge of each other, divide the Zodiac in twelve constellations, apply to them the same names, and the northern Hindoos apply the name Andes to their Himalayan mountains, as did the South Americans to their principal chain. Must we fall in the old rut and suppose no other means of populating the Western Hemisphere except "by way of Behring's strait?" Must we still locate a geographical Eden in the East, and suppose a land equally adapted to man and as old geologically, must wait the aimless wanderings of the "lost tribe of Israel" to become populated?

Beside dead and speechless relics of the past, there exists a living antiquity. In 7° south latitude, a couple of miles from the sea, there is a town of about 4,000 inhabitants called Eten. They speak, besides the Spanish, a language that some of the recently brought over Chinese laborers understand, but differ in all other respects. They intermarry brothers and sisters, uncles and nieces, nephews and aunts, i. e. promiscuously, with no apparent curse of consanguinity. They are exclusive, permitting no intermarriage into their number or with the outside world. They have laws and customs and dress of their own, and live by braiding hats, mats, and weaving cloths. They will give no account of when they came or from whence, nor does history mention them as existing before the Spaniards came, nor does it record their arrival since. Among them you will find no sick or deformed people, their custom being to send a committee to each sick or old person, and if they judge the patient past recovery or the aged past usefulness, the public executioner is sent and they are strangled. Eten orders it, they say, and none ever interfere with these orders.

Thirteen thousand years ago, *Vega*, or *a. Lyræ*, was the north polar star. Since then how many changes has she seen in our planet? How many nations and races spring into life, rise to their zenith splendor and then decay; and when we shall have been gone thirteen thousand years, and once more she resumes her post at the north, completing a "Platonic, or Great Year," think you that those who shall fill our places on the earth at that time will be more conversant with our history than we are of those that have passed? Verily might we exclaim in terms almost Psalmistic, Great God, Creator and Director of the Universe, what is man that Thou art mindful of him!

THE GREAT PYRAMID IN CONNECTION WITH CHRONOLOGY.

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ARTICLE III.

"Chronology is the science which treats of measuring or computing time by regular divisions or periods, and which assigns to events or transactions their proper dates." As time embraces events, so chronology includes history. It is a very perplexing study, on account of the wide difference of dates assigned by different historians to the same historical occurrences. Egyptologists, although they now generally agree in the order of precedence or comparative succession of events; yet they vary in the dates of *early* Egyptian dynasties, in consequence of their inability to determine whether they were coëxistent over different provinces, or successive over the whole, which would make a variation of from 1,000 to 3,000 years. Perhaps the Great Pyramid may be allowed to step in and harmonize the conflicting theories on this subject, as it has on some others. We propose to show how scholars have endeavored to determine dates in Egypt, and then what it is claimed that this gigantic old wonder, that we have found chock-full of other sciences, contains.

This huge pillar, on which uneducated eyes never saw anything to wonder at, but vastness in extent, is a magnificent school book, wonderful for its scope of scientific subjects, and marvelous for its correctness. It was made so firm, and with such dextrous skill, that it has never worn out like other books, and it has never been destroyed. It has been badly used and mutilated. It has been stripped of its plain, substantial covers, and its fly leaves have been torn. But its *lessons* have been wonderfully preserved. They seem to have been put there, as old Job said he would like to have his book printed, *with an iron pen in a rock forever.* Perhaps his desire was gratified, and this was his book! Who knows? At any rate, he seemed to have had an idea of a very durable book made in this manner. And in some way he got hold of some of the advanced science contained in this book, before Copernicus, or Kepler, or Newton did. Where did Job learn that the earth hangs upon nothing? (Compare Job 26:7, with 38:4—7, 31.) Some think Job might have been that shepherd whom Herodotus writes about, who was in consultation with King Cheops much of the time during the Pyramid's erection, and who seemed to be the architect, directing the workmen. There was such a shepherd, but that *Job was* this shepherd, this deponent saith not. But he does say that this book was made so perfect at first that it never, like other books, needed a new and corrected edition. It presented science so pure and high, that it could not have been read, so as to have been understood, till the great natural laws discovered by Copernicus and Newton were understood. Hence the reason for its remaining a sealed book so long. If its lessons had been read before, they would not have been believed, for they contradicted the current opinions of all ancient scholars. And whoever now attempts to explain

any of the scientific symbols contained therein on false principles, will fail to find anything wonderfully instructive here. It must be studied like any other book. Prof. Piazzi Smyth and others claim that this remarkably scientific volume, which antedates by thousands of years the attainment, by any known means, of the knowledge it contains, was inspired, as Solomon's temple was. Considering how it approximates perfection, does it not become critical opponents of this theory, in endeavoring to undermine it of its claim, either to convict it of error in its teachings, or show that the ancients were in advance of the scholarship of our age?

We will now show how scientists have endeavored to determine dates in Egypt; 1st, on Geological, 2nd on Astronomical; and 3d, on Monumental grounds.

1st, Geologically. Scientists argue that man has existed in Egypt in a civilized state, more than 13,000 years. How? They say that pieces of pottery, and other solid substances, have been found at so great a depth in the alluvial deposits of the Nile, that it must have required, according to geological laws, more than 13,000 years for them to have become buried so deep. But do not scholars equally eminent assert that these solid substances which are found so deep, never were buried there, but sunk down there from the top? It has been proven that there is a tendency in a solid body to sink downward, through a bed of earth made up of such fine particles as the soil of the Nile contains, and that therefore it would be utterly impossible to determine definitely any age in this way. Prof. Balfour Stewart, of Manchester, England, has been experimenting in order to test this theory, and he professes to have ocular demonstration of the fact. Concerning this tendency, we of Colorado have ample proof in our placer mines. Where do miners find gold? Invariably on bed-rock, as deep down as it is possible for the gold to sink. No one indulges the thought for a moment that the gold was buried where it is found. In accordance with the invariable laws of gravitation, when it was washed down from the mountains, it sought and found the only kind of position suited to its specific gravity, as compared with its surroundings. Only when it could not possibly go farther, did it cease to sink. But we have had in Colorado other proofs of the uncertainty of this method of determining dates, not likely soon to be forgotten. During the great flood in Denver, A. D. 1863, when the court-house, which stood on the hitherto dry bed of Cherry creek, was washed away, the iron safe sunk so deep that it has never been found to this day, although the bed of Cherry creek is usually so hard that scarcely an impression is made on it in walking over it.

A more remarkable case still occurred early last summer, about thirty miles east of Denver, when a locomotive of thirty tons weight went down in the bed of a little creek, which is scarcely wider than the locomotive's length, and has never been seen since, although the bed of this creek is usually dry and hard. When we last passed this spot, more than three months afterward, the railway company were expending about one hundred dollars per day in searching for their absconding engine, which they had been unable to find, either by driving down long iron rods, or by a steam excavator. They had, however, found the

tender and the three drowned men, whose specific gravity was not sufficient to escape so fast.

Now, suppose the soil in the Kiowa to be like what the engine has passed through, for one thousand feet deep, and that the engine should be given up as lost, and be forgotten, and that by accident it should be found, several generations hence, how many hundreds of thousands of years do you think it will then be accredited with having been buried, by some lecturer of geology of that age, and what hypothesis will he advance concerning his discovery, as connected with the lost arts?

A case somewhat similar to this occurred about twenty years ago, opposite Atchison, Kansas. A boat loaded with whisky, much larger than the locomotive referred to and of much less specific gravity, played truant in the same way in the Missouri river. The cargo of ardent spirits presented quite an inducement to search for it. The river was industriously probed with iron rods, and explored in every direction and in every conceivable way. But all to no purpose; it had gone, with *kindred* spirits, down into old Pluto's regions, where it properly belonged!

If geology can furnish no stronger proof of man's pre-historic existence in Egypt, than deep-buried solid substances in alluvial deposits, it must be set aside as an incompetent witness. For only those with whom "the wish is father to the thought," will credit such testimony. We admit, however, that this geological argument applies only to the peculiar kind of earth described. But as this is the only kind in all Egypt, where any such relics have been discovered, it covers the ground occupied in this discussion.

But it is not alluvial soil only that admits the penetration of solid substances. We know of railroads that for a considerable distance are now literally "*underground*" railroads, that sunk by their own weight, in mud which was firm enough to bear up heavy teams and to produce rank vegetation. Where the road sank it left a lake. Suppose these railroads should be discovered after our race (by some catastrophe) is destroyed; how conclusively they would prove, to some credulous creatures in the distant future, that not only we, but pre-historic man also, knew all about railroads. It is well known that a considerable portion of the Southern Pacific Railroad is now located far below the level of the Pacific Ocean. An earthquake at any time is liable to overflow it! What would such an event prove with regard to ancient ruins found beneath oceans, seas or lakes?

Would it be strange at any time if, in a large portion of Southeast Missouri, solid substances should be found far beneath the earth's surface, which sank there during the fall and winter of A. D. 1811–12? The earth there, at that time, was constantly opening, and spouting, and closing up, for months, till the mighty power which occasioned it found vent and spent itself in the terrible destruction of Caraccas, in South America. This occurred when tall trees were there, and still now are growing luxuriantly. There are many ways of accounting for the ancient underground works of man, without resorting to the *gradual* covering up thereof by successive layers of earth.

Now let us look at the astronomical argument. When the French under Bonaparte, A. D. 1798, invaded Egypt, savants were allowed to accompany the army for protection while studying Egyptian archæology. Being provided with donkeys, on which to carry their instruments, papers and specimens, they could not safely pursue their investigations without military escorts. It is said that when the army was threatened with an attack from the Mameluke cavalry, it formed into a hollow square, and the orders were: "Savants and donkeys to the center! March!" Connecting savants with donkeys was a soldier's joke, but it shows how they were protected to be enabled to accomplish their perilous tasks. They finally reached Upper Egypt, and there they discovered several zodiacs on the ceilings or walls of ancient temples or palaces. These zodiacs were constructed with the equator crossing the ecliptic on different longitudinal lines. These French astronomers took it for granted that the ages of these zodiacs corresponded with the time indicated by these crossings; so, hurriedly and exultingly, they published to the world that they had found incontrovertible evidence of the existence of civilized man in Egypt for at least 17,000 years.

The theory of proving dates by zodiacs seemed plausible without the explanations: but when explained it appeared that these painted zodiacs were mere dumb watches that told no time; that they were the work of ornamental artists, (*after the Roman conquest of Egypt*,) who had no knowledge whatever of Astronomy and who ran the equator across the ecliptic without regard to what it would signify astronomically, just as toy-makers construct dumb watches, without regard to their noting any specified time. This fact would be enough of itself to throw a doubt over the conclusions of these French archæologists. But the *fatal* argument, the one which completely *annihilated* their theory, was this: All of these zodiacs carried with them the dates of their construction, in hieroglyphic inscriptions. These French savants had not the means, at that time, of deciphering these inscriptions, (the Rosetta stone not having been yet discovered.) *Now* these dates are read and understood, and none of them are of greater antiquity than the Roman conquest of Egypt. Bunsen says, "the signs of the Zodiac were wholly unknown to the Egyptians till the reign of Trojan. So these remarkably sensational old relics, on which implicit reliance was placed for a time, in proving man's very remote antiquity, were convicted of incapacity to testify to any event that occurred before the Christian era; this is now universally admitted.

Thus was suddenly exploded the theory of man's very remote prehistoric existence, based on astronomical calculations. In accordance with an old adage, "*it went up like a rocket, and came down like a stick.*"

The only other astronomical argument determining a date in Egypt is that founded on the precession of the equinoxes, as discovered on the old, original, *real* Zodiac. This is a great clock which God Almighty made, and hung up in the heavens at the creation, to be the time-piece of the ages. It is the clock He works by Himself in running the machinery of His great work-shop. It never needs winding-up, and never stops or gets out of order. Its signs, Aries, Tau-

rus, Gemini, Cancer, etc., like the minute hand or pointer, mark with accuracy, 50.18" of a degree each year. So it will take twenty-five thousand eight hundred and twenty-seven years for these signs to get round on the ecliptic just *once.*

By seeing where the Pleiades now are, we can count 50.18" of a degree for each year till we get back to its Right Ascension, or the epoch of this grand cycle. This will count up now to four thousand and forty-eight years, or to 2170 B. C. This counting can be done, with the aid of proper instruments, by any one who understands astronomy. It is as simple as the counting of the hours and minutes and seconds on a watch. It was in this way that Herschel, Smyth and others adjusted the epoch of the Pyramid of Cheops, astronomically, at 2170 B. C., after they had learned from other sources its approximate date.

Now, we will examine this subject from a monumental standpoint.(?) Chronology, determined on monumental grounds, is based on examples more abundant and more easily understood than that which is determined astronomically.

Building monuments and inscribing events on them, seemed to be the principal business of the Egyptians. Their country is full of old stone relics, in both Upper and Lower Egypt. They include not only huge pyramids, but colossal temples, some of them hollowed out of solid rocks; tombs built in imitation of mountains, colossal obelisks, statuary, &c., which are covered all over with deep, clearly cut, hieroglyphic inscriptions, which time (in that dry climate) has not obliterated. These determine the age of the monuments on which they are inscribed as coeval with certain kings. They are the libraries of that period. Job's notion of a "*book written with an iron pen in a rock forever*," was no fanciful expression. It was the Egyptian common method of making books in Job's day.

Dr. Lepsius, the most distinguished Egyptologist in all the world, has an ancient volume of this kind, to-day, in his library at Berlin, and he *has compiled and published an Egyptian history from a monumental standpoint, chronologically arranged.* This history is of *very great value* in this discussion, because capable of being proved reliable by inscriptions on monuments now in existence. We copy, therefore, copiously from this most distinguished German scholar. He says, as follows: "An intense desire after posthumous fame, and a place in history seems to have been universal in ancient Egypt. This exhibits itself in the incredible multitude of monuments, of all descriptions, which have been found in the valley of the Nile. All of the principal cities of Egypt were adorned with temples and palaces. Towns of lesser note, and even villages, were distinguished by one temple at least—oftener more. These temples were filled with the statues of gods and kings, generally colossal and hewn from costly stones. Their walls, also, within and without, were covered with colored reliefs. To adorn and maintain these public buildings was at once the duty and pride of the kings of Egypt. But even these were rivaled by the more opulent classes of the people, in their care for the dead and in the hewing and decoration of sepulchred chambers. In these things the Egyptians very far surpassed the Greeks and Romans as well as other known nations of antiquity.

Still farther to enchance to after times the value of these ever enduring mon-

uments of ancient Egypt, it was universal with the inhabitants to cover their works of art of every description with hieroglyphics, the purport of which related strictly to the monuments on which they were inscribed. No nation that ever lived on the earth has made so much use of its written system, or applied it to a purpose so strictly historical as ancient Egypt.

There was not a walk, a platform, a pillar, an architrave, a frieze, or even a door-post in an Egyptian temple that was not carved within and without, and on every available surface, with pictures in relief. *There is not one of these reliefs that is not history*, some of them representing the conquests of foreign nations, others the offerings and devotional exercises of the monarch, by whom the temple, or portion of the temple on which the relief stood, had been constructed.

Widely different from the temples of Greece and Rome, on which inscriptions were evidently regarded as unwelcome additions, forming no part of the original architectural design, but, on the contrary, interfering with and marring it. The hieroglyphic writings were absolutely essential and indispensable to the decoration of a perfect Egyptian temple. This writing was not confined to constructions of a public nature, such as temples and tombs, but inscribed on objects of art of every other conceivable description, even the pallet of a scribe; the style which a lady painted her eye-lashes, or a walking stick; nothing was too insignificant to be inscribed with the owner's name. Inscriptions with names of artists or owners, so rare on Grecian and Roman remains, are the universal rule in Egyptian art. There was no column too great, and no amulet too small, to be inscribed with the owner's name, with an account of the occasion on which it was executed."

Chevalier Bunsen, another celebrated Egyptologist, says: "No nation of the earth has shown so much zeal and ingenuity, so much method and regularity in recording the *details of private life*, as the Egyptians. No country in the world has afforded greater facilities for indulging such a propensity, than Egypt, with its lime-stone and granite, its dry climate, and the protection afforded by its desert, against the overpowering force of nature in Southern zones. Such a country was adapted, not only for securing its monuments against dilapidation, both above and below ground, for thousands of years, but even for preserving them, as perfect as the day they were erected. In the north, rains and frost corrode; in the South the luxuriant vegetation cracks and obliterates the monuments of time. China has no architecture to bid defiance to thousands of years. Babylon had but bricks. In India the rocks can barely resist the wanton power of nature."

Renan, in alluding to the exceeding plain and unmistakable records of their doings as seen in their hieroglyphic inscriptions says, very quaintly: "*We have Egypt caught in the fact.*"

These ancient monuments, being all in old Egyptian style, were, till the beginning of the present century, erroneously supposed to have been about equally ancient. But when the hieroglyphics were deciphered, they corrected this mis-

take, so that now, in the nineteenth century, we know more about Egypt than any people before for thousands of years.

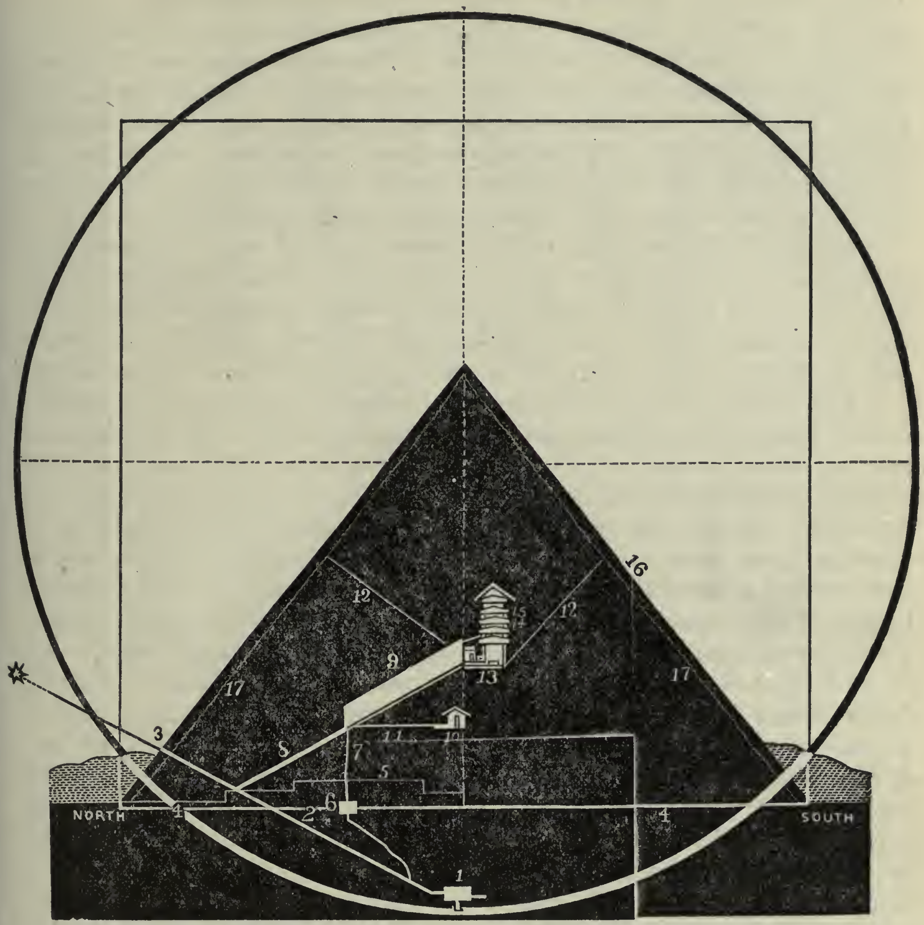
According to Young and Champollion, the great hieroglyphic scholars and expounders, these stone structures were erected at widely different times, and under very different circumstances. They not only carry their own evidence with them of their proper place in a chronological table, but show conclusively that they belonged to four distinct epochs:

1. The first and oldest of these are the Pyramids. 2. *The second and next, in order of age, are the most ancient of the temples in Upper Egypt.* (These were built before and about the time of Shishack, of the twenty-second dynasty, who was contemporary with King Solomon. *3. Those of the third epoch were erected after the conquest of Egypt by the Greeks. 4. Then follow, fourthly, those erected after the conquest of Egypt by the Romans.* It was on these last ones that artists and house-painters inscribed Zodiacs. As none of the Zodiacs referred to were found on the ruins which belong to the first three epochs named, it is evident that they could not have been older than the monuments of the fourth epoch, on which they were inscribed.

Among the pyramids, which signalize the first epoch, the Great Pyramid of Cheops is accredited as being the oldest. *Dr. Lepsius calls it "the first link in all monumental history, not only in Egypt, but in all the world."* No one will contend that there is any better authority. In producing his evidence that this pyramid is the oldest, he says, Cheops attached the figure of a pyramid to his signaure. This was, at least, symbolical testimony that he built the pyramid; and no such figure was found attached to any earlier king's signature, although several of Cheops' successors, who also built pyramids, adopted the figure in their cartouches. King Cheops' signature has been discovered on the underside of stone in the pyramid, where it could not possibly have been inscribed upon it after it was erected. So it is admitted that he is the most ancient king in the world whose name has been found on a monument of his own construction.

The history of Egypt before Cheops, during the three previous dynasties, is all traditional and mythical; for the previous kings are known in tradition only as god-kings, who belong to the realms of mythology rather than reliable history. Copies of their cartouches or signatures, from Merces of the first dynasty, down to the third, are handed down to us by tradition, but as there are no monuments in existence on which they have been found inscribed, they do not come within our range of argument in a scientific discussion, which is based on *monumental* testimony. *Now it is claimed that in the avenues and other internal arrangements of the Pyrawid of Chepos are found, not only the date of its erection, but also a symbolical history (older than letters) of Judaism and Christianity, chronologically arranged, which agrees with both the facts and Bible history of the same.*

Such chronology as this includes not only a history of the past, but of the future! It is prophecy! And, as Hume says, "Prophecy is a miracle!" So be it! And perhaps this pyramid may yet prove, even to the most skeptical, that a miracle is possible. Who knows but the building itself (though unlike any



XUT=SPLENDID. PYR-MET or PYRAMID OF CHEOPS.

1. Lower chamber. 2. Descending passage. 3. Entrance. 4. Natural rock platform. 5. Natural rock. elevation. 6. Cavern. 7. Well hole. 8. Ascending passage. 9. Great Gallery. 10. Queen's chamber. 11. Passage from the Great Gallery to Queen's Chamber. 12. Passage for ventilation. 13. King's chamber. 14,15. Small apartments above King's Chamber. 16. Outer surface with casing. 17. Outer surface with casing removed.

Angle of slope of 1st Pyramid, 51°, 51′, 14.3″. Angle of slope of 2d Pyramid, 52°, 20′. Angle of slope of 3d Pyramid, 51°, 0′.

SECOND PYRAMID. UR=GREAT.

THIRD PYRAMID. HIR=SUPERIOR.

other building that man ever dreamed of), fulfills certain prophecy? "In that day there shall be a pillar to the Lord, at the border of Egypt, and it shall be for a sign and a witness to the Lord of Hosts." (See Isaiah 19, 19-20.) The question is often asked, "What was this pyramid built for?" Who knows but the correct answer to this question is contained in this prophecy? If it was built under Divine guidance, to prove that the God of Revelation is the God of true science could the language of prophecy have been framed so as to fit it better? Even to its exact location, it is literally just *at* Egypt's border.

Gardner Wilkinson, in his "Hand Book of Egypt," says, "Ancient Egypt included only the valley of the Nile." The adjoining desert was not regarded as a part of it any more than is the Mediterranean Sea regarded as a part of the Atlantic Ocean. The line which defines the *boundary* of Egypt is so marked between Egypt and the Desert that a person may step from one to the other."

And is it any more incredible that Chronology, full-grown and mature, should demand rooms beforehand in that enduring pillar, while in process of erection, where he could tarry and bear witness that Revelation and *true* Chronology are in harmony—is this any more incredible than that his elder brethren, Astronomy and Mathematics, venerable with myriads of cycles, should be on hand and direct in its perfect construction, and then, like mighty giants, straddle and surround it and wait there, themselves, through the ages, till their testimony, in favor of *pure* Astronomy and *pure* Mathematics is received and acknowledged? We fail to see how, if we admit the one, we can fairly be charged with *credulity* in admitting the other. But the *one* we *must* admit! It has been mathematically demonstrated! We cannot demonstrate Chronology as we demonstrated Mathematics any more than we can morals. Future chronological events we must decide upon, as we decide upon the future rising of the sun, by its regularity in the past. Is this fair? Unless, then, we can show that the so-called time-tables have heretofore marked beforehand important events, as they occurred, we will not pretend that it is reasonable to believe that they will do it in the future. But suppose they have invariably marked important events correctly (before they occurred) thus far, is it unreasonable to expect they will do it in the future? Say, skeptic! What objection is there to this rule for testing a future chronological chart?

We are aware that this theory opens a new field of investigation for scientists—one at variance with preconceived notions and prejudices—a field that is particularly inviting to the visionary and superstitious, and which sound logicians, if obstinate, are likely to shun on that account.

That the sciences of Astronomy and Mathematics are there in their modern garb is plain. We have seen here accurate measurement of great distances, and a division of symbolical astronomical circles so as to divide time correctly. We have seen also among the measures of the pyramid, a scale, with an inch representing a year, applied in marking the precise duration of the precessional period.

Now we will examine the claims that history, before its occurrence, chronologically arranged, is symbolized in its avenues and internal arrangements:

When you put intricate machinery together, so that it exactly fits, the probability is that you have put it together aright. For example, a watch would not run unless it was put together aright. Our English ancestors when they recorded deeds of conveyance, duplicated them, placing one on each end of a single parchment. Then these were cut apart on indented lines; that is, lines like saw teeth. The fitting of these two pieces of parchment together was proof, equal to a seal, of their genuineness; hence the origin of the word indenture for deed. The proof of chronology, like that of prophecy is in the occurrence or denting of the described events into the specified dates. For example, a British lord once rudely asked—

> His valet if he knew
> An argument or fact to prove
> His cherished Bible true?
> The terms of disputative art,
> He had not learned to use,
> So pointing to a synagogue,
> He said, "My lord! THE JEWS!"

Jewish history, anomalous as it is, exactly fits or dents into Jewish prophecy!

Now this is all that there is to the claim concerning the pyramid's chronology of future events, the wonderful fitting or denting of one into the other. That some of these fittings may be mere coincidences, we do not deny. But to believe they all are, it seems to us would require more credulity than to believe they are not. Such a combination of wonderful accident would be more marvelous than the realities.

Now let us examine this fitting of corresponding records which are independent of each other. And we will begin with the earliest historical event plainly recorded in hieroglyphics on any of the old Egyptian monuments, corresponding with the same event as recorded in Scripture. This was the plundering of Solomon's temple by Shishouk I, of the 22d Egyptian dynasty. This event is sculptured unmistakably on the walls of the temple of Karnac in Upper Egypt. Champollion, on entering this temple, saw at a glance a hieroglyphic description of a triumph, where the captives were plainly Jewish in their features, and where "Melek Aindah," King of Judah, was sculptured out so conspicuously that it could be interpreted as readily as on the day when it was put there. The scripture account of this reads thus, see 1 K., 11:40:

40 Solomon sought therefore to kill Jeroboam. And Jeroboam arose, and fled into Egypt, unto Shishak, King of Egypt, and was in Egypt until the death of Solomon.

And 14; 25, 26:

25 ¶ And it came to pass in the fifth year of king Rehoboam, *that* Shishak, King of Egypt, came up against Jerusalem:

26 And he took away the treasures of the house of the LORD, and the treasures of the King's house; he even took away all; and he took away all the shields of gold which Solomon had made.

[See, also, 2 Chron. 12; 2–11.]

Here are corresponding records that dent in, or fit together, as to the events, so as to prove beyond doubt, their occurrence. They also prove conclusively that Solomon and Shishon I, were contemporary, and that Solomon's temple must have been built during the 22d dynasty, when Egypt was at the climax of her prosperity and power. But the exact date before the Christian era that this event occurred, is not so easy to determine. The foundation of Solomon's temple was laid probably between 1010 B. C., and 1027 B. C. Pool places it in his chronology, at 1010 B. C.; Usher at 1012 B. C.; Bunsen at 1024 B. C.; Hales at 1027 B. C. Here is a difference of seventeen years in the extremes of these calculations. This is as near as we can arrive to the date of this event, from any of the sources here quoted.

The earliest symbolical record of any event found on any monument on the earth, corresponding with a similar record found in profane history, is that of the erection of the great pyramid by King Cheops of the 4th Egyptian dynasty, whose signature is still in existence on a monument of his own erection. Osborn fixes this date, historically, at between 2108 and 2228 B. C., and Wilkinson at between 2089 and 2123 B. C. The astronomers Herschel, Smith, and others, after obtaining the approximate date of its erection, historically found it necessary to adjust this date so as to correspond with the fact of its facing exactly the four cardinal points. Such perfect orientation they concluded could not possibly have been obtained at that day (long before compasses were invented) without the aid of a star, exactly south, in connection with the one at the North pole. The time of erection thus adjusted by them, was determined at 2170 B. C., when the stars Alpha Draconis, and Alcyone were exactly on the same celestial meridian, one north, at the pole, and the other south, at the equator, at mid-night, and coincidently with the vernal equinox. Here is a historical date corrected and regulated by the signs of the zodiac, or the great clock of the ages, which is reliable. And it is said that this *historical* date so adjusted, corresponds exactly with its own *monumental* date, which we will soon explain.

Here we have two points of time established with reasonable definiteness, one at about 1020 B. C., and the other at 2170 B. C. Between these dates there is an interval of 1150 years, which is covered entirely over by 18 Egyptian dynasties from the 4th to the 22d inclusive, making an average of only 65 years to a dynasty. Considering there are only three more dynasties previous to these, is it not rather extravagant to speak of Egyptian dynasties extending over tens of thousands of years? One writer, determining not to let the fashion of the age get ahead of him, has made out on paper 300,000 years of civilized life in Egypt before the creation of the pyramids. I ask, in the light of what we have proved from the pyramid of Cheops and Solomon's temple concerning the average length of Egyptian dynasties, if the Bible account of the first settlements in Egypt is not the most rational of any. Egypt in Hebrew is called Misraim. What more reasonable than that Misraim, the grand-son of Noah, was its founder, and that his son Copt was the ancestor of the ancient Copts? Sir Gardner Wilk-

inson says, that Egypt is called Arabac Misr., from Misraim, the second son of Ham, which in Coptic is spelled Chme. He adds, that tradition has it, that Ham had a fourth son called Copt, who conquered all Egypt and gave it his name. (See hand-book of Egypt.)

Egypt has very properly been called the monumental land of the earth, as the Egyptians were the monumental people of all history. It is the first country that has a history. If, then, as is admitted, monumental history is more reliable than all other, ought not this most effectually to dispose of those extravagantly long and fanciful periods (which some speaks of as existing) before the Pyramids? Do you ask, Why? We answer, Because there are none of those "most reliable of all evidences" (monuments) to prove it.

We have now examined in order the evidence from Geology, Astronomy and Stone Monuments, as gathered by the most profound scholars the world has ever produced, in order to learn Chronology from the Egyptian stand-point. No one pretends that there is any better place than Egypt to obtain the information desired. We have been enabled to explore back far beyond the origin of written language as expressed by letters. Lord Bacon has said: "Hieroglyphics preceded letters." May we not add with propriety, they were letters in embryo, and preceded written words, as "coming events cast their shadows before." These hieroglyphics were of three varieties: 1st, Those which symbolized objects; 2nd, Those which symbolized ideas; and, 3rd; Those which symbolized sounds. Our ablest scholars tell us that these Egyptian hieroglyphics and symbols antedate the most ancient of all languages ever written by human beings; that they are older than any book in China or India; older than the Zend of the Persians, the Vedas of the Brahmins, or the Sanscrit of the Hindoos. To all of these languages, therefore, there is a limit in their age, and we are able, from the stand point taken, to determine approximately what that limit is. Now there is no difficulty in determining relatively the date of this oldest of all monuments—the Great Pyramid. It carries its own evidence with it in King Cheops' signature that it was built in the fourth dynasty. But to determine exactly how many years before the Christian era this occurred, is quite another matter.

Prof. Smyth claims to be able, however, to determine very closely this date in two ways. The first is by the precession of the equinoxes, which we have already explained. The other is by the interpretation of symbolical marks, on what he considers a historical time table. But how can time for 4,000 or 5,000 years, including the epochs and history of Judaism and Christianity through 1542 years of the one and 1881 years of the other, be symbolized? How can this be done so as to agree with the Bible history of the same, including character? Is such a thing possible? Let us see! A lifetime has been charmingly symbolized under the figure of a highway, with its ups and downs, etc., in that inimitable allegory by Dr. Johnson, entitled "The Journey of a Day the Picture of Human Life."

What is the beautiful allegory of Bunyan, but religious history symbolized in roads marked so plainly that any one can interpret the symbols? Here is

the destination of one class. There is the destination of another class. Here is the wicket-gate; there is the Slough of Despond. Up there are the Delectable mountains. What was the journey of the Hebrews, from Egypt to Canaan, but one grand symbol of pure Christianity?

If you were to show a traveler the way to some distant point, which to him is all in the future, would you not trace out for him on paper, symbolical roads, marking objects of interest on his way, at commensurate distances, to the end of his journey? We have been accommodated many times by such symbolical highways, marked out for us by some obliging guide, and we have found them reliable.

Well, the first crucial test of Prof. Smyth to prove that the avenues in this structure (which of itself is a symbol of our earth) symbolized chronological periods, was made in applying his measuring scale (of an inch to a mile) to the date of its erection. To his astonishment, it matched it exactly, (see figures.) It *dented* right in, at 2,170 inches north of the beginning of the grand gallery. And right there, within an inch of that measurement, were perpendicular (erect) lines, cut in both walls, from top to bottom, as if to attract attention to that spot. Then, to add emphasis to this symbol of erection, the stones here were erected, from their usual inclined position at right angles with the slope, to a perpendicular (erect) position as much as to say, "Attention! traveler! erection right here!" Could an erection be symbolized more effectually than by erecting something? The act of building is now one definition of erection; and might not the act of building the great pyramid be symbolized by a sign signifying erection before written words had been invented?

These erect lines and erect joints mark a distance from the entrance of three hundred and fifty-seven inches. No landmark was ever more permanently established than was this one first established mile-post on our journey through this symbolized earth. It is as plain to-day as when put there over five hundred years before the birth of Moses.

Now it is claimed that this erection or "act of building" occurred 628 years before the exodus of the Jews. Exodus signifies departure; and right at the 628 inch mark, south of the established sign-post, labeled "Erection," we find the first departure or (Exodus) in the road. The symbolized sign-post here reads, "Exodus" as plainly as the preceding one read Erection. Like a voice from a friendly guide, it says: Pilgrim! Look here! Exodus right here! A new departure here. See! It is an up-hill road, rather steep! At the same angle upward that the road we left was downward.

As in Bunyan's symbolical travels, there is but one place of beginning; where all mankind start on life's journey; so it is here. But like that also, there are two places of destination, one below, and the other above. At the start, all go as the dragon (Alpha Draconis) points, one way, which is a downward, slippery road, that ends in a filthy, unventilated, unfinished cellar or vault, patterned after a tomb, far beneath the earth's surface, where total darkness reigns supreme. The avenue thither is only about four feet high, (47.3 inches and 41.5 wide. So

a traveler on this road is compelled to go with his back painfully bent, as though pressed downward with a heavy load, without the possibility of either rest or comfort. But after proceeding to the second sign-post, marked 'departure' or (Exodus), one whole nation turns off the old road under "Divine guidance," and proceeds upward, where climbing takes the place of sliding, but where the passage-way continues equally contracted as the other, and furnishes no rest for the weary. The destination, however, at the end of this road, is in wonderful contrast with the destination of the other. It ends at the ante-room, or entry to a spacious chamber, with most beautiful red granite walls, polished like the finest jewelry, of the most exquisite workmanship. The only article of furniture which it contains is a magnificently wrought red granite chest, without lid, corresponding in capacity, exactly with the ark of the covenant of Moses, and exactly $\frac{1}{100000}$ of the size of Noah's ark. One quarter of the capacity of this chest corresponds exactly with the one-quarter grain measure of Great Britain. This room is so situated and so ventilated with fresh air, by two large tubes, that the atmosphere is neither too cool nor too warm, about 68° Fahrenheit, (50° of its own Thermal measure,) and never changes. This chamber so symbolized of beauty and perfection, comfort, is farther above the earth's surface than the unfinished dismal vault at the end of the other road is below it.

Now, why is not this as good a symbol of religious history as "Bunyan's Pilgrim's Progress?" These avenues and internal arrangements mean something. Let any one who can, give a better interpretation of them. We do not insist, at this early stage of our investigation, that we cannot possibly be mistaken. But we do say now, that the coincidences are marvelous, and in harmony with the other marvels already considered.

Freemasons have told us that among their very ancient symbols, a man erect was a symbol of what? Of perfection! Now in these symbolical roads there is no place where a man can stand erect till he symbolically is in Christ. It certainly agrees with Scripture that no perfection can come by the Mosaic ritual, and that the Jewish code never made a person perfect. [See Heb. 7., 19.]

Now let us follow Judaism from their exodus sign-post 1542 inches, for the 1542 years of their history, till we reach the Christian era, and what do we find then at this new epoch in history, both sacred and profane? Evolutionists and Deists, Jews and Christians, all acknowledge the historical event of the birth of Christ every time they date an account! What does A. D. 1878 mean, if not that the Christ of the Bible is the Christ of history, and that his birth marked an historical epoch? Now right here what do we see? A great and sudden expansion in the road; not side-ways! It is no broader than before. But it does expand upward; toward Heaven! It is exactly seven times higher than before, and walled with exactly seven courses of over-lapping stones on each side. A person need not go bent down any longer, as though carrying a heavy load. He can now stand erect and walk erect if he choses, till he reaches the very entrance to his destined abode. If you were to try your hand at an effort to symbolize man's natural downward tendency and end, with Judaism and Christianity as

scriptually described, do you think you could improve on their peculiar symbolical arrangements of the pyramid of Cheops? They were put there for some purpose, and in other pyramids. What was that purpose? We have answered this question in one way. Let us have a better explanation, if possible. Who will instruct us as to what all these symbolical roads and rooms mean?

But we have not done yet with these religious symbolisms. At this point representing the commencement of the Christian era, just where the road becomes inviting and pleasant, the Jewish nation fly the track, and take a new departure. Now, they neither incline upward nor downward, but go earthward, horizontally, on a road which also ends in a room not to be despised, although far inferior to the one above. This room is on the 25th course of masonry. Could you symbolize Jewish history since the epoch of Christianity in any better way than this? What does the room at the terminus of their horizontal earthward road symbolize, but the earthly wealth and aggrandizement which they have already reached at as their climax of desire to worldly prosperity? This, too, is strictly in accordance with their choice and Bible prophecy, concerning this wonderfully anomalous race. Whether the well on this last route signifies their sinking under the Roman power to rise again in a spiritual sense, at the prophetically appointed time, or whether it has any other symbolical meaning, we are not prepared to say. We are not fully satisfied that we understand at all the symbolical signification of this well. That it represents the resurrection of Christ, appears to us fanciful.

Now, here is a structure situated among idolaters and built by idolaters. Their other monuments are all covered over with symbols of their idolatrous forms of worship. But this one contains no allusion to any religion except Judaism and Christianity. What does this wonderful fact mean? Herodotus obtained from Egyptian priests a tradition that King Cheops suspended idol worship, closed the idol temples and forbade the offering of sacrifices to idol gods, during the erection of his pyramid. The reason suggested by some why Cheops was not buried there, was, that he so incensed the idolatrous natives by his prohibition of idol worship, during the erection of the pyramid, that they would not permit it.

Now, if it be asked what reason we can give for using one inch to a mile rather than ten or one hundred, in these measures, we answer: First, because it fits; secondly, it is the measure which we have shown was used before on this level. The distance around the pyramid on this fiftieth course of masonry is 25.827 inches. The circle described by using the vertical height from this point as a radius is, in length, 25.827 inches. This is the number of years that the pyramid's governing star, Alcyone, will be in performing its grand cycle on the ecliptic, twenty-five thousand eight hundred and twenty-seven years.

We have never examined the symbol in the internal arrangements of the pyramid of Cheops, bearing on Chronology. There are others which we must defer till another time. We are aware of the liability to interpret erroneously this kind of language; we may think we find symbols where there are only coin-

cidences. Bunyan undoubtedly made mistakes in his interpretation of some of the symbols of Solomon's temple. The most intelligent expounders of the Scriptures differ widely in their intepretations of the most significant symbols of the New Testament, (Baptism and the Lord's Supper). We remember a temperance lecturer who said that the reformation of John the Baptist was the reformation of drunkards: because inebriates walked crooked and when reformed walked straight—this man of one idea thought he saw in John's "walking straight paths" a symbolism of the reformation of drunkards. Prof. Smyth is charged with weakening the authority of his symbolical discoveries by some fanciful theories which are only hypothetical. The attributing to Melchisedek the architectural superintendency of the pyramid's erection is one; this he has since retracted. Then these last chronological monuments do not exactly agree with the chronological charts which we have been in the habit of consulting. The year A. D., 1881, will end about 1881 years from Christ's birth, but not from the exact, true historical epoch of Christianity as we understand its history. (See Luke 16, 16.) We hope the distinguished professor will explain.

We all need to be cautious when traveling new roads in the dark, lest, by endeavoring to avoid a ditch on the one side, we are plunged into a slough on the other. The advice given by an able expounder of symbols, in old times, is as good now as ever: "Prove all things. Hold fast that which is good."

ANCIENT OLLA MANUFACTORY ON SANTA CATALINA ISLAND, CALIFORNIA.

During my explorations along the Pacific coast I paid much attention to the discovery of the workshops of one of the most beautiful articles of true aboriginal workmanship. It is the *olla*, a cooking vessel made of a species of steatite, the pot stone, or *lapis ollaris*, of old, of which Theophrastus and Pliny speak as a material used for the manufacture of vessels among the ancient eastern nations. My observations and notes, which I made while working on the mainland, pointed to the islands in the Santa Barbara channel as the locality in which the munufacture was carried on. I expressed the opinion in my report to the Smithsonian Institution (Hayden's Bulletin, Vol. iii, p. 50), that the site must be looked for on Santa Catalina island. During my last year's visit to that island, on behalf of the Peabody Museum, I discovered the first quarries in the locality called Pots valley. The pits and quarries revealed the busy hand of the aborigines, among the *debris*, and in the partly-covered pits where cooking vessels were found in all stages of finish, from the boulder, but partly worked out from the rock and still firmly attached to it, the globular form roughly rounded, the boulder in which the excavation has already been commenced, and so on to the smoothly finished pot. All the implements with which the task was accomplished were also found, and, by observing the progress of the work in the many specimens discovered, it was not difficult to ascertain the mode of manufacture, the result of which I made the

subject of an essay accompanied by illustrations (Report of the Peabody Museum, 1877).

Not only were cooking vessels extensively manufactured on this island, but also flat dishes (which the Mexicans call *Coniales*), cups, pipes, stone rings which were used as weights for digging-sticks, and all kinds of trinkest. These articles constituted the money of the people of Santa Catalina, like the shell beads of the neighboring island of Santa Cruz, where they were extensively manufactured by the aboriginies, and whence they were distributed far along the coast, and, to some extent into the interior. The quarries are more abundant in number towards the south-eastern end of Santa Catalina, where for about two miles square not less than three hundred quarries and pits were discovered, during my last visit, with a large number of pot-boulders, sherds, tools, etc.—*Paul Schumacher.*

GEOGRAPHY.

CONGRESS AND THE NORTH POLE.

AN ABSTRACT OF ARCTIC LEGISLATION IN THE CONGRESS OF THE UNITED STATES.

BY CAPT. H. W. HOWGATE, U. S. A.

II.

THE SECOND GRINNELL EXPEDITION.

Immediately upon the return of DeHaven, Mr. Grinnell, the owner of the vessels which formed his expedition, generously offered them for another cruise in search of Sir John Franklin, if Congress should think proper to authorize it. Congress did not accept this offer, and Mr. Grinnell placed one of them—the Advance—at the disposal of Dr. Kane, who, at the solicitation of Lady Franklin, had been authorized by the Secretary of the Navy to lead a new American expedition in search of her lost husband.

The expedition was a private one, so far as outfit was concerned, Mr. Peabody, of London, contributing largely for this purpose. In addition to Dr. Kane, ten of the party belonged to the U. S. Navy and were attached to his command by orders from the Department, and without special legislation in either case. Dr. I. I. Hayes, subsequently distinguished in the same field of exploration, was attached to the vessel as Surgeon.

The following extract from the Annual Report of the Secretary of the Navy,

under date of Dec. 4, 1852, gives the official record of his action in the matter:—

*   *   *   *   *   *

"Lady Franklin, whose devotion to the cause of her unfortunate husband has excited so large a sympathy in the United States, has been encouraged to make another effort to determine the fate of the gallant navigator of the Arctic seas, and is now intent upon the organization of a new expedition, under the auspices of our countrymen, Mr. Henry Grinnell, of New York, and Mr. George Peabody, of London. * * * * *

The distinguished lady, whose sorrows have inspired this zeal of adventure and whose energy has given it an intelligent and hopeful direction, has done no more than justice to a meritorious young officer of our Navy, Passed-Assistant Surgeon Kane, in asking his co-operation in this hazardous expedition. * *

The request of Lady Franklin, to enlist Dr. Kane in the new expedition has been handed to me and I have not delayed to give him the necessary permission and to confer upon him all the benefit he may derive from his position in the Navy by an order which puts him upon special service.

If it should become requisite in the field of operations to which he is destined to provide him with the means for the prosecution of scientific study beyond those which may be afforded by the Department and the liberality of the distinguished gentlemen who have assumed charge of this expedition, I would commend it to the enlightened regard of Congress with the most confident hope that that body will respond to the suggestions of this necessity with a prompt appreciation and generous support of an undertaking so honorable to humanity and so useful to the enlargement of liberal science." * * * *

Dr. Kane's assignment to duty in connection with the expedition was issued in November, 1852, as follows:

NAVY DEPARTMENT, WASHINGTON, D. C., November 27, 1852.

SIR:—Lady Franklin having urged you to undertake a search for her husband, Sir John Franklin and his companions, and a vessel—the Advance—having been placed at your disposition by Mr. Grinnell, you are hereby assigned to special duty for the purpose of conducting an overland journey from the upper waters of Baffin's bay to the shores of the Polar seas.

Relying upon your zeal and discretion, the Department sends you forth upon an undertaking which will be attended with great peril and exposure. Trusting that you will be sustained by the laudable object in view, and wishing you success and a safe return to your friends, I am, respectfully, your obedient servant,

JOHN P. KENNEDY, *Secretary of the Navy.*

Passed-Assistant Surgeon, E. K. KANE, *U. S. Navy.*

In February the scope of his duties was enlarged by the following additional instructions:

NAVY DEPARTMENT, February 9, 1853.

SIR:—In connection with the special duty assigned to you by the order of this Department, bearing date Nov. 27, 1852, your attention is invited to objects of scientific inquiry, particularly to such as relate to the existence of an open

Polar Sea, terrestrial magnetism, general meteorology and subjects of importance connected with natural history.

JOHN P. KENNEDY, *Secretary of the Navy.*

The expedition sailed from New York, May 30, 1853, and reached Upernavick, in Greenland, July 24, and Dr. Kane's report of his arrival at this place was the last tidings received of him or his party for more than two years, during a portion of which time they were mourned as sharers of Sir John Franklin's fate.

In the fall of 1854 the friends of the missing navigators became alarmed at their long absence and took steps to have a naval vessel sent in search of them. As this required legislation, application was made to Congress for the necessary authority, and December 18, 1854, Mr. Brodhead, of Pa., submitted for the consideration of the Senate the following resolution:

Resolved, That the Committee on Naval Affairs be instructed to inquire into the expediency of sending a steamer and tender to the Arctic seas for the purpose of rescuing or affording relief to Passed-Assistant Surgeon, E. K. Kane, of the United States Navy, and the officers and men under his command.

On the 19th the Senate proceeded to consider this resolution, and the following extracts are made from Mr. Brodhead's remarks in its support:

* * * * * *

"Lady Franklin urged him to take command of another expedition in search of her husband; Mr. Grinnell gave his tried vessel, the Advance; Mr. Peabody of London gave $10,000; and Dr. Kane used his exertions as a lecturer and his influence with different scientific institutions to make up the rest. He had, however, succeeded but partially, when Mr. Kennedy, the then Secretary of the Navy, took an important part in consummating the scheme. He gave Dr. Kane orders, as a navy officer, to take command of the expedition, assigned to him the services of several warrant officers and seamen, provided hospital and other stores, astronomical and nautical instruments, &c., &c., furnished the vessel with a library, and finally ordered Dr. Kane to report fully to the Department on his return. The cause of science was thus to be advanced by governmental aid. * * * Dr. Kane is a gallant officer, conducting a hazardous and meritorious enterprise with the consent and under the orders of the government, and hence it becomes the duty of a generous Government, representing a generous people, to take measures for his rescue or relief. We have officers and men unemployed; officers have already volunteered and there will be no difficulty in procuring men of the best sort, and I therefore hope the resolution will be adopted."

There was no opposition, and the resolution was adopted without discussion.

On the same day—December 19th—Mr. Fish, of New York, presented the memorial of James Brown and others, of New York, praying that an expedition be sent to the Polar seas for the purpose of affording relief to Dr. Kane, his officers and crew; which was referred to the Committee on Naval Affairs.

In the Senate, January 10, 1855, Mr. Brodhead called up the matter and said:

The Committee on Naval Affairs to whom were referred memorials from the Chamber of Commerce, New York; from James Brown and others, of New York; from the Board of Trade, of Philadelphia; from the Board of Trade, of Boston; from the Life Saving Benevolent Association, of New York; from the Marine Insurance Companies of New York; from the American Philosophical Society, of Philadelphia, and others, asking Congress to extend relief to Passed Assistant Surgeon Kane, have instructed me to report a joint resolution respecting the Arctic Expedition, commanded by Dr. Kane."

The joint resolution was read a first time, and ordered to a second reading.

Mr. Brodhead urged immediate consideration, but objection being made by Mr. Badger, it went over.

SENATE, January 15th, 1855.

On motion of Mr. Brodhead the joint resolution was taken up, and after a brief discussion passed with an amendment, providing that the steamer and tender should be officered and manned by volunteers from the Navy and others who may declare their willingness to be so engaged.

Previous to the vote: Mr. Hunter, of Virginia, expressed a doubt as to the propriety of the proposed expedition, as probably involving the government in an endless series of expeditions.

Mr. Mallory, of Florida, in reply, gave a brief statement of Dr. Kane's plans, which included provision for such an emergency as had actually arisen, showed that the object of the proposed expedition could be accomplished in a few months without serious risk or loss.

In the House of Representatives the friends of the missing ones had not been idle, as the following record shows:

DECEMBER 11, 1854.

Mr. Florence, of Pa., asked consent to offer a resolution providing for an expedition for the relief of Dr. Kane, but objection was made by Mr. Jones, of Tennessee, and the resolution was not received.

DECEMBER 14.

Mr. Wheeler, of New York, introduced a memorial on the subject from the Chamber of Commerce, of New York, which was sent to the Committee on Naval Affairs.

JANUARY 22d, 1855.

Mr. Pennington, of New Jersey, presented a memorial in favor of the Kane relief expedition, from the Governor of New Jersey and the State Legislature, which was referred to the Naval Committee.

Mr. Chandler, of Pennsylvania, asked consent to take from the Speaker's table the Senate joint resolution, and called attention to the necessity of speedy action.

Mr. Smith, of Virginia, objected and the matter went over.

JANUARY 25th, 1855.

Mr. Chandler, of Pennsylvania, again tried to get the resolution from the Speaker's table, but objection was made by Mr. Millson, of Virginia.

JANUARY 29, 1855.

The Speaker laid before the House a communication from the Governor of Pennsylvania, transmitting copy of a resolution adopted by the Legislature of that State, in favor of an expedition to rescue Dr. Kane and his crew.

Mr. Florence moved its reference to the Naval Committee, when Mr. Chandler again asked that the Senate joint resolution be taken up, and after some discussion the rules were suspended, and after an eloquent statement from Mr. Chandler of the circumstances under which the relief was rendered necessary, the resolution passed, in the following words.

Resolved, By the Senate and House of Representatives of the United States of America, in Congress Assembled:

That the Secretary of the Navy be and he is hereby authorized to provide and dispatch a suitable naval or other steamer, and if necessary a tender, to the Arctic Seas, for the purpose of rescuing or affording relief to Passed Assistant Surgeon E. K. Kane, of the United States Navy, and the officers and men under his command;

Provided, That such steamer and tender shall be officered and manned by volunteers from the Navy and others who may declare their willingness to be so engaged.

(Approved February 3d, 1855.)

Money was now needed to fit out the search expedition, and this was speedily provided, as the record shows that in the Senate March 3d, 1855, the Naval Appropriation Bill being under consideration, the following amendment was offered by the Committee on Finance and adopted:

"To enable the Secretary of the Navy to carry into effect the joint resolution respecting the Arctic Expedition commanded by Passed Assistant Surgeon E. K. Kane, or so much thereof as may be necessary—$150,000."

The time for preparation was limited; but with the aid of energetic officers and the active and praiseworthy co-operation of the naval contractors and mechanics at the navy yards of Brooklyn and Philadelphia, two small vessels were admirably and rapidly fitted out.

Excellent officers volunteered—good seamen enlisted—complete supply of provisions and clothing for two years of rough exposure was laid in, and on the 4th of June the little party of brave and philanthropic adventurers left New York Harbor, amid the encouraging cheers of their countrymen, who knew so well how to appreciate such acts of daring and humanity. The expedition consisted of two vessels—the barque Release, and steamer Arctic—and was commanded by Lt. Henry J. Hartstene, U. S. Navy, who received the following instructions for his guidance:

NAVY DEPT., May 25, 1855.

SIR:—A resolution of Congress, approved Feb. 3, 1855, authorizes the Secretary of the Navy to provide and dispatch a suitable naval or other steamer, and if necessary, a tender, to the Arctic seas, for the purpose of rescuing or affording

relief to Passed-Assistant Surgeon, E. K. Kane, of the United States Navy, and the officers and men under his command.

The barque Release and steamer Arctic, having been procured, and especially fitted and equipped for this service under your supervision and inspection, with full rations and extra provisions for two years, and clothing peculiarly adapted for the climate of the Arctic region, and such officers and men detailed as the department, as well as yourself, considered necessary and sufficient, and the command of the expedition having been already assigned to you, you will, so soon as the above named vessels are, in all respects, ready for you, proceed with them, by all means as early as the first of June, in the prosecution of the object of the resolution of Congress. Economize as much as possible in the way of coal. * * * * * *

J. C. Dobbin, Sec'y. of Navy.

The following named officers of the Navy were attached to the vessels of the expedition:

To the "Release."—Commander H. J. Hartstene, Commander of the Expedition; Lieutenants, William S. Lovell, and Joseph P. Fyffe; Assistant Surgeon, James Laws, and Boatswain Van R. Hall.

To the "Arctic."—Lieutenant Commander, Charles C. Simms; Lieutenant, Watson Smith; First Assistant Engineer, Harman Newell. Dr. John K. Kane, brother of the explorer, was attached to the Arctic as Medical Officer.

The story of their achievements and the successful relief of Dr. Kane and party, is briefly but eloquently told in the report of the Secretary of the Navy, J. C. Dobbin, as follows:

* * * * * The recital of their hair-breadth escapes, their terrible conflicts with nature, which seemed to mock their efforts—their alternations of sad misgivings and sustaining hopes, impart truly an air of romance to this unostentatious exhibition of genuine heroism. In about four months with their little barques, they sailed *eight thousand miles*, fully circumnavigated Baffin's Bay, passed further north into Smith's Sound at the northern boundary than any one save Dr. Kane, and nearly to Beechy Island—visited a village of Esquimaux, from whom, after hours of difficulty, by means of signs and drawings, they learnt the point to which Dr. Kane and his party had directed their course—immediately changed their route, found the unhappy party at Disco Island, and returned them in safety to their country and friends—thus accomplishing the benevolent purposes of Congress."

The relief expedition reached New York on its return, October 11th, 1855.

In the House of Representatives, March 7, 1856, Mr. Tyson, of Pennsylvania, on leave, presented resolutions passed by the Legislature of Pennsylvania, of thanks to Dr. Kane and his officers and crew for the successful result of their recent expedition to the Polar region, which were laid on the table and ordered to be printed.

March 11, 1856, Mr. Tyson, by unanimous consent, introduced the following preamble and resolution, which were read, considered and agreed to:

WHEREAS, The intrepid conduct and scientific zeal of Dr. Elisha Kent Kane in his late expedition to the Polar regions in search of Sir John Franklin, aided by the officers and men under his command, have placed his name in the first rank among Arctic explorers; and,

WHEREAS, The observations and discoveries he has made are important additions to geographical and meteorological science, and valuable in the light which they shed upon the currents of the ocean; upon the mysterious changes in the magnetic needle, and upon the physical laws of this globe; and

WHEREAS, The narrative of these heroic labors and their magnificent results, should be widely diffused as well to encourage the spirit of scientific research among our countrymen as to express the profound sense we entertained of the merits and services of the explorer; therefore,

Resolved, That the Committee on the Library be instructed to inquire into the character of the book about to be issued by Dr. Kane, as to letter-press, illustrations, and binding, and report their opinion of the expediency of ordering a certain number of copies thereof for use and distribution.

The attempt to connect the Government with a private firm in publishing an unofficial narrative of a prlvate expedition, was unsuccessful, as will be seen from the following extracts from the *Globe*.

APRIL 16, 1856.

Mr. Tyson, from the Library Committee, submitted a report on the resolution for the purchase of Dr. Kane's Narrative, and recommended the purchase of fifteen thousand copies for the use of Congress; also recommending that medals be struck and presented to Dr. Kane, his officers and men, respectively, as an expression of the high estimation in which Congress held their merits and services. After a long discussion, in which considerable feeling was manifested, the resolution was passed as reported.

SENATE—March 12, 1856.

Mr. Bigler, of Pennsylvania, presented the resolution of the Pennsylvania Legislature, and moved their reference to the Committee on the Library, with instructions to inquire into the expediency of purchasing for the use of the Senate a certain number of copies of Dr. Kane's Narrative, to be published in Philadelphia. In the course of his remarks upon the resolutions, Mr. Bigler said:

* * * * * "The feats of the most daring on the field of battle are not better calculated to touch the chords of the American heart, and to command general admiration, than the startling discoveries and thrilling adventures incident to the career of a daring navigator and explorer. The feeling is peculiarly strong with an enterprising and progressive people.

* * * * * * * * * *

"The Royal Geographical Society of England has by resolution assigned to him a front rank among Arctic explorers. It has also in store for him, as I learn, a personal compliment in the shape of a gold medal. The French Government, also, ever magnanimous in its recognition of genius and courage, and generous in its patronage of the arts and sciences, has congratulated the Doctor on his triumphs. The Legislature of Pennsylvania, Kane's native State, have

thanked him for the honor his career has conferred upon her people. The Legislature of New York, by unanimous consent, have evinced their estimate of the expedition by presenting its leader with a gold medal. Complimentary resolutions have also been passed by the Legislatures of Maryland and New Jersey.

* * * * * * * * * *

"Some of the ancients we read honored civilians as well as soldiers, and surely in no age, ancient or modern, should the daring navigator and discoverer command less of his country's admiration and bounty. The brave man who plants the flag of his country in the enemy's camp, is worthy of distinction, but not more so than he who extends the limits of civilization and human knowledge at the risk of life and the loss of health and comfort. The most desperate in battle do not evince a higher degree of true courage.

* * * * * "They are entitled to the gratitude and admiration of the whole human race, and will be to the end of time."

* * * * * * * * * *

Mr. Seward, of New York, submitted a substitute for the resolution, which was accepted by Mr. Bigler and read as follows:

Resolved, That the Committee on the Library be instructed to purchase, for the use of the Senate, ten thousand copies of Dr. Kane's Narrative of his late Expedition to the Arctic regions, from Messrs. Childs & Peterson: Provided the price shall not exceed five dollars per copy.

Mr. Brodhead, of Pennsylvania, suggested an amendment, that if the Committee found the work to be a useful one, and yet not consider it expedient to purchase an unofficial book, a bill be reported authorizing a direct money payment of $10,000 or $20,000 to Dr. Kane. He doubted the propriety of going into partnership with any publishing firm in the United States, and cited the amount voted Commodore Perry for his services in the Japan Expedition as a precedent.

Mr. Bigler stated that Dr. Kane felt a delicacy in appearing before the country as a claimant for pecuniary reward, and hence he thought the plan indicated by the resolution the best.

After a brief discussion the subject, on motion of Mr. Seward, went over until next day.

SENATE, March 13, 1856.

The consideration of Mr. Brodhead's amendment was renewed and discussed at length without any definite result, and it was again postponed.

SENATE, March 24, 1856.

Mr. Seward called up the resolution concerning Dr. Kane, and his substitute was adopted, as follows:

Resolved, That the Committee on the Library be instructed to inquire into the expediency of some legislative recognition of the eminent services and success of the recent expedition of Dr. Kane to the Arctic regions.

SENATE, April 18, 1856.

The joint resolution for the purchase of Dr. Kane's forthcoming work, and

for the presentation of medals, was read twice and referred to the Committee on Library.

SENATE, August 11, 1856.

Mr. Pearce, of Maryland, from the Committee on the Library, reported back the resolution for purchase of books and presentaton of medals, with an amendment and a written report, and asked immediate consideration, unless debate was likely to ensue. At the request of several Senators it went over, and the report was ordered to be printed.

SENATE, August 18, 1856.

The joint resolution was reached on the calendar, and on Mr. Clay's motion its consideration was postponed until the second Monday in December.

SENATE, Dec. 18, 1856.

Mr. Pearce called up the joint resolution and stated that the recommendation of the Library Committee which had it in charge was to strike out the clause providing for the purchase of 15,000 copies of Dr. Kane's work, and retain only the clause to provide medals. The title was changed to correspond with this recommendation and it passed as amended without debate.

HOUSE OF REPRESENTATIVES, March 3, 1857.

On motion of Mr. Tyson the House passed the joint resolution awarding medals to Dr. Kane, as amended by the Senate, in the following words:

Resolved, By the Senate and House of Representatives of the United States in Congress assembled,

That the Secretary of the Navy shall cause to be struck and presented to Dr. Kane, his officers and men respectively, such appropriate medals as in the judgment of the said Secretary shall express the high estimation in which Congress holds their respective merits and services.

Approved March 3. 1857.

SENATE, April 2, 1856.

Mr. Mason, of Virginia, from Committee on Foreign Relations reported a joint resolution granting permission to Dr. Kane and his officers to receive from the British Government some expression of their thankfulness for services rendered in connection with the search for Sir John Franklin.

The resolution was supported by Messrs. Cass and Mason, and opposed by Messrs. Crittenden, Bayard and Reid, and modification suggested by Messrs. Seward and Toucey; but went over without action.

SENATE, May 26, 1856.

Mr. Mason of Virginia, called up the resolution authorizing Dr. Kane and the officers associated with him in his arctic expedition, to receive certain presents from the British government, and recommended its passage. After a brief discussion the yeas and nays were ordered, and resulted, yeas 33, nays 4.

HOUSE OF REPRESENTATIVES, Aug. 30, 1856.

Mr. Pennington called up the joint resolution authorizing acceptance of testimonial from the British government, and it was passed without debate.

The following is the text as passed:

WHEREAS, The President of the United States has communicated to Congress a request from the Government of Great Britain that permission should be given by this government allowing Dr. Elisha K. Kane, a Passed-Assistant Surgeon in the navy of the United States, and the officers who were with him in his late expedition to the arctic seas in search of Sir John Franklin, to accept from the government of Great Britain some "token of thankfulness," and as a memorial of the sense entertained by that government of "their arduous and generous service" in that behalf.

Be it therefore resolved by the Senate and House of Representatives of the United States of America in Congress assembled, that Congress hereby consents that Dr. Elisha K. Kane, of the navy of the United States, and such of the officers who were with him in the expedition aforesaid as may yet remain in the service of the United States, may accept from the government of Great Britain such token of the character aforesaid as it may be the pleasure of that government to present to them.

Approved August 30, 1856.

In the Senate, Feb. 24, 1857, Mr. Fish called up the following joint resolution which was passed after a brief discussion of its object:

"The Secretary is hereby authorized to pay to the officers and seamen of the expedition sent in search of Dr. Kane and his companions, while on duty in connection with said expedition, the same rate of compensation that was allowed to the officers and seamen in the expedition under Lt. De Haven; and to such officers as were not mentioned in said expedition, the following additional compensation, namely: The lieutenants and masters, the pay of a lieutenant commanding; the first-assistant engineer, the pay of a chief engineer; and the clerk, the pay of a secretary to commander of a squadron.

This resolution was referred to the committee on naval affairs in the House of Representatives Dec. 7, 1858, and was reported adversely from that committee, January 14, 1859, by Mr. Sherman, of Ohio. It therefore failed to become a law.

The following resolution, approved March 16, 1858, closes the favorable Congressional action in relation to this expedition:

Resolved, That the officers and men engaged in the several expeditions which have been fitted out in the United States for the recovery of Sir John Franklin and his companions be authorized to accept the medals recently transmitted to this government for presentation to them by the government of Great Britain.

The new artesian well which is being bored, under the direction of Mr. Richard, C. E., at Vitoria, Spain, has now reached a depth of nearly 2,200 feet. The diameter of the bore is about 20 inches. The drills are worked by a 32 horse power steam engine. All the machinery is described as being of the most perfect and effective character. It is hoped that one of these days the drills will reach a subterranean river capable of supplying the city with an abundance of the purest water.

CORRESPONDENCE.

SCIENCE LETTER.

PARIS, October 28, 1878.

The ideal of an hospital is, a temporary structure, built for five years, then burned—then replaced. Failing this, the wings of an hospital ought to be well separated, only one or two stories high, and but few patients in a ward. The Algerian section at the Exhibition, shows a model hospital, consisting of 18 wings, 25 yards asunder, only one story high, each ward containing 40 beds. The pavilions ought to be 100 yards apart and the beds less numerous. Air is admitted by ventilators over each bed; the vitiated air escapes by the chimney. Each patient breathes 80 cubic yards of fresh air per hour. Stoves are now banished from all wards, and the air is so distributed, that it will circulate through every nook and cranny of the ward, not like the bed of the river, where the current is strongest in the middle and stagnant at the sides. In Summer when there is no fire in the chimney, a jet of gas is kept burning therein, which thus draws off the vitiated air. In the Menilmontant hospital just opened, M. Ser does not allow the air to enter the wards till it be filtrated and moistened, by passing through cotton, which arrests thus any disease germs. The wards are oval, so that impure air cannot lodge in corners; the walls are varnished, which allow them to be washed, while remaining impermeable, and during the cleansing process, the inmates are changed to another ward. There are distinct wings for small-pox cases, and for the accouchement of women. Athens and Melbourne remind us, they separate persons affected with ophthalmia. Hospital beds ought to have no curtains; the latter serve to store up the seeds of disease or suffocate the patient. Besides wooden shanties, M. Levy exhibits his tent hospitals, as employed by him during the Crimean war, and that the Americans employed so successfully in Paris during the siege. The canvas makes a capital partition, and allows the tent to be adequately heated, even when the external air is several degrees below zero. Holland presents a wagon containing the equipments for a canvas hospital, and 50 quarts of water; it can be installed in an hour, and the air is regulated by a weather cock on the summit. Belgium invites attention to a field hospital, where the india-rubber over-alls of the soldiers constitute the chief material. England and America hold the foremost place with respect to apparatus for moving invalids in beds, chairs, etc.; some of the inventions are works of extraordinary ingenuity. As healing agents, hot and cold water are very efficacious, but must be prudently dealt with, the best plan is to vary the temperature; the warm, correcting the stimulating action of the cold, and inducing nervous reaction. These are the principles only of the Turkish or Roman bath, good for healthy people,

but fatal for those liable to cerebral, lung, and heart affections. There is an instrument exhibited for gargling the throat, and M. Malcz claims, to inject balsamic and mountain air, into sick chambers. However, nothing can replace the light air of mountains and its complement—the exercise, though throat ailments are benefited by respiring an atmosphere impregnated with tar or turpentine; hence the value of a residence in the pine forests of Ardcaebon, near Bordeaux.

The Germans patronize largely baths of compressed and rarefied air. Professor Schnitzler of Vienna, exhibits some curious apparatus under this head; the patient can himself graduate the density of the air: the bath is portable, and affords undoubted relief to the asthmatic, but delicate lungs should take care, as lesions might be produced, and so dangerous bleeding. Recently Dr. Bert recorded a death from the air bath. Artificial gymnastics, walking, measured hill ascensions and singing are safe pulmonary exercises.

Dr. Onimus in 1875, first drew attention to a functional disorder experienced by telegraphic clerks, that they call themselves cramps, similar to what writers and violinists occasionally suffer. The malady is apparently peculiar to the working of the Morse telegraph, and causes a difficulty to co-ordinate the movements which aid to form alternately the dots and lines. The doctor states, the nerve-centers play an important part in this cramp; the cause is not alone to be attributed to the frequent repetition of the same movements, but also to irritability. Having to transmit or receive 7,000 signals per hour, or 49,000 for a total of seven hours work, the clerk not only endures muscular contraction, but much fatigue from excessive tension of the mind. This fatigue is revealed at first, by a contraction in the back of the neck, a phenomenon peculiar to an excess of cerebral attention on the part of those who write much, or largely correct proofs, and known by the feeling of heaviness and uncomfortableness in the posterior part of the head. On experiencing these symptoms all brain work ought to cease, and the sufferer to take a walk, indulge in moderate physical exercise, or seek relaxation in some other mental labor.

It is estimated that the French infantry soldier, owing to the absence of equilibrium in carrying his rifle, expends unnecessarily, an amount of force, equivalent to an addition of two pounds weight to his outfit: he balances the butt by the barrel, whereas the German soldier displays no uneasiness in shouldering his gun. But the step of the German, physiologically regulated in 1864 is different from that of the French soldier. The point may be settled when a decision is come to as to what kind of boot is best for a linesman, and whether flannel or cotton, is better for troops' shirting, as preventive of colds.

M. Bouilland has confirmed his experiments made in 1829, namely, that no organ experiences pain, if the sensitive nerves surrounding it be untouched. Thus, he has been able to prick the hearts, the lungs, and the brain of living animals, without their expressing pain, but the moment the nerve of the coatings was touched, sensation was painfully felt.

M. Bellesme has made the buzzings of insects a life study. It is an error to believe the buzz comes from the wings exclusively. Rēdumur cut off the wings

of a fly and it continued to buzz, but in a sharper key. Take a horse-fly when on the wing, the buzz is grave, an octave; this ceases if the wing be removed. But the sharp sound, never observed when in flight, is now perceptible if the insect be held prisoner; it vi-whizzes rather than struggles, due to the movements of the thorax, and which, vibrating 300 times per second, stir the air in its vicinity, thus producing the sharp buzz. It is owing to these yellow and strong muscles of the thorax being less developed in the butterfly, and the movements thus restricted, that no buzzing noise is perceptible.

No solution has yet been offered respecting the designs upon the slate rocks, in the almost inaccessible valley of Tenede, and that the Minister of Public Instruction has had copied in 1877. The designs are those of oxen and stags, of arms, and of other unknown objects—for the artistic talent is very primitive. The peasants attribute them to the soldiers of Hannibal, which is an effort of the imagination, and some trace a likeness between them and the designs to be found in the Canary islands and Morocco. Scientists are cautious about "explanations," since the Abbè Domenech's misadventure twenty years ago. He went to convert the Red Indians, and found an old copy book full of eccentric signs; concluding he had a "find," he returned to France, and assisted by the Empress, published the *fac simile* of his "Savages' Book." Critics soon discovered it was an old scrap book in Celtic, that amused the tedium of an Irish backwoodsman. Also, M. Reboux has just shown us, that the flint instruments, presumed to have preceded the age of metals, and previous to pre-historic man, are in daily use among Oceanic aboriginals.

M. Paul Bert has made known to the Academy of Sciences, the explanation of certain diurnal motions in plants, of which the sun is cause of their wakening, and its absence, of their sleep. What is the soporific substance at the base of the flower or the leaf, that is the medium of this change? Bert pounded the movable parts of the sensitive plant, and found they contained grape sugar, while the other portion of the stem and leaves had none. The leaflets produce under influence of the sun, the sugar, which lodges in the stalk, and toward evening attracts gradually the water of the stem, and hence, an augmentation of the moving spring, as it were. No sugar is formed during the night, when the sun returns, or light, the tension on the side of the leaflet is diminished, while the opposite side increases in energy; thus movement follows in virtue of the diminished tension in the part exposed to the light.

Lisbon shows at the Exhibition a model of her abattoir, the most perfect of slaughtering establishments in existence, Paris not excepted. Yet the Lisbon butchers opposed the construction of a building, where in addition to supplying primary uses, it prepares the skins, intestines, and tallow of the animals, without the slightest prejudice to health. Tripe is an article of food in much demand among limited purses. It is the inner coating of the stomach; instead of separating it, by continued trampling on the stomach by dirty laborers, it is there obtained by previously steeping the organ in water at 130 degrees, when it readily peels off.

Among the food supplies at the Exhibition must be remarked the excellent collection of bitters, not at all to be despised when prepared from plants; they stimulate jaded appetites, and give a tone to many a patient's stomach. Algeria produces excellent bitters—as well as Holland and Turin; she exports sardines, and also tomatoes in the form of sauce. Sweden and Norway send excellent preserved fish, a food at once light, nutritive, and easily digested, and on which the armies of these countries largely live. The samples of preserved meat by salicilic acid, are superior to those prepared from salt. The conserved fresh meats are more or less good, but opinion would desire that they were excellent. Parisians have made up their minds, that of all the canned food placed on the market, lobster, and next turkey, alone enable themselves to be recognized by their taste when on the table. Liebig's extract has fewer deficiencies than other like substitutes, but lacks many desiderata. Vevey sends a patē steeped in an essence of soup, and salted: it is calculated to render a service during campaigns. The same locality has an excellent food for the old people, and infants about being weaned—a patē formed of toasted bread made from superior flour, mixed with the purest concentrated milk from Norway and Switzerland; for adults there is a powder composed of milk and chocolate. Algeria exhibits excellent honey, which has the great advantage of really coming from the bee.

M. Chancourtois, professor of geology in the Ecole des Mines, has illustrated the formation of the earth's mountain chains and valleys, by the cooling of the mass when in a state of fusion. He represents the earth by an india-rubber balloon, which he places in a bath of melted wax: he inflates the balloon, which in time becomes coated with the melted wax, and destined to represent the molten crust of the earth; the coating of wax on cooling, forms mountains and valleys, resembling very accurately the chains now existing on the globe.

The captive balloon is not so much an amusement, as an important scientific fact. It cubes nearly 28,000 yards, almost the double of the largest balloon ever yet made. It is 160 feet high, or 21 feet less than the *ascenseur* of the Trocadero, it can carry 50 passengers 660 yards high. The difficulty was to find a tissue thoroughly impermeable, as in time gas escapes through ordinary tissue; a special stuff was prepared, consisting of 7 layers, alternately, of muslin, India rubber, and linen, with a coating of drab zinc paint. The boat is a circular balcony, 20 yards in circumference, with a "way" for passengers, three feet wide. The cable can resist a pressure of 25 tons. The gas employed is pure hydrogen. The cable is wound round a drum, worked by machinery, and in the paying out, or taking in, no shock is felt. On ascending no sensation is experienced, save a slight dinning in the ears; the earth seems to descend into a gulf; all objects become lilliputian, and if the sun shines, the shadows of objcets fall inversely. Were a sudden gust of wind to break the cable, which is strong enough to resist double the greatest storm pressure of our latitudes, the balloon would not run away farther than the outskirts of the city; there are two escape pipes, one of which is four feet in diameter, and all the apparatus for a speedy descent, under an

experienced aeronaut, is ever ready. The "lifts" at the Trocadero form another kind of ascension; the turrets are 110 yards above the Seine, and the summit of the landing balcony is 69 yards; the piston, corresponding in height, and weighing 20 tons, pushes up a cage sliding between four columnar rails, containing 60 people. The up and down voyage is similar to a mine, only the speed is of the lightning kind. The piston, of course, descends a similar depth into the soil, and is forced upward by a jet of water falling from the summit of the tower underneath it. Shutting off this column of water, with a break in the shape of weights and pulleys, allows the piston and its attached cage to descend. Engines pump the water into a reservoir on the summit of the tower. We are pleased by the view from the turret, but we are astonished and fascinated by that from the balloon.

F. C.

GEOLOGY.

GEOLOGY OF LAGRANGE COUNTY, INDIANA.

BY E. S. EDMUNDS.

To the geologist there is, perhaps, no other state in the Union, between the Mississippi River and the Atlantic Ocean, the Great Lakes and the Gulf of Mexico, that presents so many remarkable phases in geological structure, as our own state of Indiana. In many respects it resembles that of New York, viz: In the north we find the Silurian, the Devonian toward the central portion, and the Carboniferous in the south. In addition to this, we have evidences of the Glacial epoch, which has wrought many wonderful changes in many portions of the state, as will be seen by Prof. Collet's report* of Owen county, which is as follows: "From the northwestern corner of the county to the southeastern, a broad belt of from six to ten miles wide, embraces a hilly, almost mountainous, region, in which high hills and deep valleys alternate in close succession. It presents many extensive views full of wild and picturesque beauty. From a point on the divide, some distance northeast of Patricksburg, an illusion having an important bearing on the past geologic history of the county was noticed. Thence the surface of the elevated area and ridge-tops sloped gently to every point of the compass. The deep ravines were hidden by the wall-like ridges with their mantles of tree and bush, leaving no hint of the profound valleys one hundred and eighty to two hundred and fifty feet deep, which largely occupy this area. From that standpoint was revealed the ancient rocky surface of the county, as it came from the hand of nature, modeled in the bosom of the ocean, a great plain sloping

* Geological Survey of Indiana, 1875.—E. T. Cox.

gently to the west, northwest and southwest, before the currents of ice-water, in the glacial age, demanding egress to the south, had eroded their deep valleys."

Recollecting the fact,* mentioned in the foregoing general description, that the original surface presentation of this county, as it emerged from the mother carboniferous ocean, was a great plain, sloping gently to the west, with two slight ridges guarding to the north and south, the depression or gulf-like basin, three or four miles wide, about and west of Patricksburg, in which the block coals were prepared and deposited, the question naturally occurs, to what causes may the well-developed system of hills and valleys be attributed.

There is no evidence of volcanic energy; little, or none, of earthquake action, except the slow, gentle oscillation, by which the crust of the earth is continuously raised or depressed over large areas continently. Close observation will at once discover agencies, in the long past, of adequate power. The elements are nature's great agents—water, air and heat: ice, her great plow; water her graver; and air and heat her moulder. With them and time, she has accomplished the denudation and erosion of mountain, plain and valley. We have but little knowledge of the long period which followed the emergence of this region, till the Glacial age. We know that it was long enough for the Permiassic, Triassic, Jurassic, Cretaceous and Tertiary seas, in the great valley of the continent to the west, to develop and sustain their wondrous life under a tropical clime. This was followed by a period of intense cold, which has left many records of existence, graven with a pen of ice, "*on the rocks forever.*"

The glacial epoch on our continent is divided into two periods,—the first, in which a deep, massive river of solid ice flowed up the St. Lawrence valley, plowed out the beds of Lakes Ontario and Erie, resting its ice foot along a ridge still seen in Northern Ohio and Northeastern Indiana, and discharging a flood of ice-water, melted by the warmth of each recurring summer's sun, by sluice-ways (present river valleys) into the Ohio and Wabash rivers. At Put-in-Bay and Kelly's islands, vast surfaces are planed off as smooth as a floor, others grooved and striated, each mark indexing the course and initial point of the mighty ice machine, and recording a mysterious chapter of the book of nature. The general course of this flood was along the axis of these two lakes, and an average of the observations made was that its direction was south 80° west. Of this period, we have only fragmentary evidences in this state. Of the second glacial period, the evidence is apparent to the *careless* observer. The records are easily read. It was subsequent to the St. Lawrence flow, for on the Bay Islands, the southern shore of Lake Erie and wherever else observed, its striæ override and its debris obliterates the marks and channels of the latter. It came from the extreme north, loaded with Arctic granites. Crossing Lake Superior, it took up iron-ore-copper, queenstone and pudding stones from Keneenaw Point and the Manitou, line Islands. Divided by the peninsula of Michigan, the larger stream flowed solidly up Lake Michigan, hewing out its bed, and thence, pushed by congela-

* Ibid.

tion in the rear or drawn by the ice vacuum in front, poured its rigid current over the northern half of Indiana and Illinois. Probably of extreme thickness at the north, the ice sheet did not have a height of over two hundred to four hundred feet in Central Indiana, as measured by the Glaciometer."*

That the northern portion of our state has been covered, at some period, by a vast sheet of ice, there cannot be a shadow of a doubt. To some, who are skeptics regarding the great and sublime truths of geology, this may seem almost impossible. But here are the proofs, written as with legible characters, and graven upon the very rocks themselves. The track of the tornado is strewn with the debris that was scattered during a fearful and devastating period, short, but terrible in its effects upon human life and the habitations of men.

The glaciers, as has been shown by Agassiz and others, move quite slowly, but, in the course of their passage, collect great quantities of rock and other detached portions of matter, and deposit them, in many cases, at a great distance from their starting-point. The path of a glacier may be known by the grooves cut in the solid and almost unyielding rock. Often the rocks are found planed off as smoothly as if done with a plane; there are evidences of the "graver." Then, from these facts, we conclude that these deposits of sand, gravel and boulders were brought from the icy regions of the North, and deposited as known glaciers deposit their contents—by the melting of their substance. With these remarks for an introduction, I now begin my subject proper.

The geographical situation of LaGrange county is as follows: It lies between 41° 30′ and 41° 45′ north latitude, 85° 15′ and 85° 40′ west longitude. It is bounded on the north by St. Joseph county, Michigan; east by Steuben county, Indiana; south by Noble county, and west by Elkhart county. It covers an area of three hundred and eighty-four square miles, or two hundred and forty-five thousand seven hundred and sixty acres. The county seat is LaGrange, a thriving town of about two thousand inhabitants. Like many of the northern counties of Indiana, this county is dotted with numerous lakes, which add much to the beauty of the landscape, beside exerting marked changes in the climate and healthfulness of the county. These climatic phases, however, are not without their exceptions, as we shall see in the future.

Nearly two-thirds of the county is beautiful prairie, which is named in its different portions, according to different historical or natural data. For instance, one division, situated in the northeastern part, is called "English Prairie," from its having been settled by a colony of English emigrants; another is named "Mongoquinong Prairie," after a tribe of Indians of the same name; the third division is called "Pretty Prairie" because "dame Nature" bestowed her favors so lavishly upon it. As is the case with most prairies, they are all nearly level. The remainder of the county is rolling and covered with numerous swamps and marshes, which, while they are the source of much malaria, afford excellent pasturage. There is only one large stream that flows through the county, and, while it is small for a river, is too large to be called a creek. It received the

* Ind. Rep., 1874, fol. 82.

name of White Pigeon River, nearly half a century since, from an Indian chief, who was buried at a small village in Michigan, which was named after him also.

On the prairies, the soil is a dark, sandy loam; and in many instances, is nearly black. There is, however, but a small per cent. of sand; in most places this renders plowing very difficult, except with the most highly polished steel plows. The soil upon the openings is much lighter colored, and contains much sand and gravel. This soil requires high manuring and a limited amount of cropping to keep it up in good condition. On the other hand, the prairie soil is very productive, to a great extent, owing to the rich deposits and strata of alluvium that have been bountifully deposited over the surface during the recent geologic period. The low swamps and marshes are very productive after under-draining; this soil is well adapted to most of the cereals and furnishes a good quality of *humus* so necessary for plant-life. Good water is obtained at an average depth of about forty feet. It is generally impregnated with lime, magnesia, iron, sulphur, and occasionally with sodium. The highest land of LaGrange county is about *seven hundred feet* above the level of the sea. The lowest cannot be more than one hundred feet less, and, as we have no mountains and lakes, situation and air currents mostly govern our climate. Like other portions of this country, the climate is subject to extremes of heat and cold; and, in such a degree, that only two or three hours are required to effect a change of several degrees in the thermometer. Owing to the number of marshes, much *malarial* matter is thrown off, causing a great amount of ague, bilious and other fevers. This does not, however, extend to the highland, as a rule, but is confined to the low, marshy districts. Meteorologists tell us that there is a belt of country south of the "Great Lakes," extending nearly one hundred miles, with a uniform breadth of about forty miles. Over this area of nearly *four thousand* square miles, during the warmer portions of the year, the atmosphere is heavily charged with malaria, which creeps into the human system, causing fevers and ague in abundance. But, notwithstanding these unhealthy phases of its climate, it is regarded as a very fine country.

LaGrange county lies wholly within the Boulder Drift, or Quaternary epoch, except the extreme northwestern portion, which is a modification of the above epoch. In the central and western portions of Van Buren township, traces of the Silurian and Devonian periods are found. In the drift, we find, in this locality, evidences of powerful upheavals, which have brought the rocks of those early epochs up to the clear sunlight, and, by their fossiliferous appearance, we can read them; obtaining, as from the leaves of a book, a knowledge of the animal life of those periods. Owing to the thickness of the Boulder Drift, which is, perhaps, upward of a hundred feet, it is rather difficult to determine the thickness of each strata. In boring wells, in this and other counties around us, a distance of from eighty to two hundred and twelve feet was passed through before reaching the underlying rocks of the Devonian age. From what I have seen, and from the statements of well-diggers and those engaged in boring for water, I have learned that the clay formation is most predominant; with a little

sand and clay on the top, interspersed with now and then a boulder. This develops the fact that the great bulk of the recent formation is clay. This clay near the gravel, is often very compact, and it is then called hard-pan. Sometimes, in boring for water, the auger strikes a large boulder; in such cases the auger must be withdrawn and another trial made in a new locality. Generally after going through the hard pan, water is found in the layer of sand below. The outcropping of the Silurian and Devonian epochs, as I remarked before, shows conclusively that a tremendous upheaval must have occurred to bring the old series of rocks to the surface; and other phenomena connected with the formation; there was most certainly a *powerful volcanic action.* That the Silurian and Devonian seas are strongly marked in this section there can be no question. One has only to take a little pains to gather up the leaves of the book, and it can be read, as a history, full of grand and interesting thoughts.

I said that evidences of the above epochs are abundant, and, to prove my position, I will name the fossils in the order of their periods, using the classification of Prof. Dana in his Manual of Geology. I shall consider, in this article, that the reader is somewhat familiar with the origin of the names of the different periods so that a rational idea of the subject may be obtained.

Lower Silurian.—In the Primordial or Cambrian period we first find the Acadian epoch, consisting of conglomerate and slate; this is not, however, found in any considerable quantities. I have seen some very fine specimens of conglomerate (pudding stone), and have in my possession specimens containing stones of many different colors. Now, whether this conglomerate was upheaved, or brought during the *drift-period* I am not able to decide.

Potsdam Epoch.—The rocks of this epoch are evidently of sea-shore origin, and, in most cases, marked with ripples. Through their substance the tracks and boring of worms can be distinctly traced. In my cabinet, I have a piece of the rock, which not only shows the holes eaten by the worms, but the minature eggs, requiring the microscope to reveal them, are as plainly to be seen as though they had been deposited there but yesterday. From the size of the borings, these worms were probably something near the form of our common "angle worm" of to-day. Different phases of the rock appear, in which they bear the marks of "rain-pits." As though, while lying upon the beach, a heavy rain had fallen, and the largest drops had left their imprint in the soft mud that lay upon the shores of those early Silurian seas. In the language of Dana, "The Primordia rocks have afforded evidence only of marine life." In the classification of the animals of this epoch, "the species observed are all intervertebrates; they pertain to the four sub-kingdoms—Protozoans, Radiates, Mollusks and Articulates." Of the Radiates, perhaps the Brachiopoids are the most abundant fossils of the Silurian.

Families.—Those most abundant in this section are the Spirifer, Orthis and Lingula.

Genera.—*Spirifer striatus*, *Calceola sandalina*, *Siphono treta* of the Spirifer family. *Strophomena planumbona* and *Orthis striatula* of the Orthis family. Of

the Lingula family the *Obolus Appollonis*, *Lingula Matthewi* and *Discina Acadia* with a number of species of the *Trilobite* are found. Passing to the next epoch, which is the

CHAZY—We find numerous species of coral, among which the *Retepora incepta* and *Ptelodictya fenestrata* are the most predominant. Some imperfect specimens of the *Maclurea magna* and *Scalites angulatus* are met with occasionally together with other fossils of this epoch.

TRENTON EPOCH.—This, the last but two of the Lower Silurian, figures very extensively in the geology of Van Buren township. The seas of this epoch were densely populated with animal life. That this is true, I think the testimony of the rocks shows most unequivocal evidence. Even in this region I find the representatives of nearly all the sub-kingdoms. Among the Radiates, corals of various kinds abound, prominent among which are the *Petrai corniculum* and *Columnaria alveolata*. Of the class of *Polyps*, as well as *Crinoids*, the *Graptolithus amplexicaulis*, *Chœtetes lycoperdon*, are numerous. The Brachiopod family represented are the *Orthis lynx*, *Orthis occidentalis* and *Orthis testudinaria*; the latter are very numerous. Of the *Gastropods*, the *Murchisonia bellicincta* and *Pleurotomaria lenticularis*, to which is added the *Cephalopods*, *Orthoceras junceum*, *O. vertebrale*, *Ormoceras tenuifilum*, *Cyrtoceras annulatum*, *Cryptoceras nudatum* and *Trocholites Ammonius*.

Of the CRUSTACEANS, the Trilobite family is well represented: *Asaphus gigas*, *Calymene Blumenbachii*, *Lichas Trenotensis*, *Agnastus bobatus* are the most abundant.

UTICA AND CINCINNATI EPOCHS.—Among the fossils of these epochs we notice those most numerous: *Favistella stelata*, *Halcysites gracilis*, *Syringopora obsoleta* and *Tetradium fibrosum* of the *Radiates*; *Ambonychia radiata*, *Modiolopsis modiolaris* and *Orthonota parallela* of the Mollusca. The Articulates are represented mostly by the Trilobite family, among which are the *Asaphus platycephalus*, *Calymene blumenbachii* and *Trinucleus concentricus*.

According to Dana, the whole thickness of the Lower Silurian Period, over this section of our state is about seven hundred feet, or about the same as that of the state of Illinois. Leaving the above period, we ascend to the

UPPER SILURIAN AGE.—In which we find "Marine life, large oceans, &c." These features continued to characterize this period as they did the Lower Silurian. In the Niagara Period occurs, in naturnal order, the Medina Epoch, which is not worthy of mention; but the Clinton and Niagara epochs reveal their history most gloriously. The outcroppings of the latter produce great quantities of lime in some portions of the state, while here only the characteristic fossils are to be seen; these consist of the following animals: *Arthrophycus Harlani*, *Linguella cuneata*, *Modiolopsis orthonota*. The following represent fossils of the Clinton group: *Zaphrentis bilateralis*, *Palœocyclus rotuloides* and *Chœtetes*. The first is commonly known as the "cup-coral" and resembles in form, exteriorly, the end of a cow's horn, broken or cut off.

In the Niagara group, those most common are: *Conophyllum Niagarense*,

otherwise known as the "cup-coral," *Favosites Niagarensis*, which is a columnar coral so named from *favus*, a honey-comb, which it strongly resembles, *Halysites catentulata*, or chain-coral, and *Heliolites spinipora*. Many fine specimens of the *Favosites* and *Halysites* can be picked up in the fields where they have lain for ages; scarcely dimmed by their exposure to the elements; they lie with their bright faces upturned, seeming to say, "study me and I will relate a truth to you that you will not find elsewhere." The fossils of this group, to the geologist, are of the most interesting character. When placed under a powerful magnifier, they reveal cells of the most complicated structure, the sides of which are as symmetrical as the cells of the honey-comb. To see these cells filled with a formation as hard as crystal, and with such regularity, having been upheaved by igneous or volcanic action, and having lain for countless ages, now coming to the light of intelligence, the mind is filled with grandeur and sublimity. Niagara, with all its power and glory, can scarce awaken a stronger series of emotions in the heart of the geologist and lover of nature, than the numerous inhabitants of those early periods of this planet's existence.

DEVONIAN AGE:—Occasional traces of the Flora of this age are found, among which are the Conifer species of the earliest known genus of the family Prototaxites. Of the Fern family, the caulopteris antiqua is represented. These undoubtedly were chief among the trees of the Devonian forests.

ANIMALS.—Chief among the fossils of the Fauna of this age, are the following: Zaphrentis gigantea, Zaphrentis Rafinesquii, Philliprastrea Verneuili and Favosites Goldfussi. I have not found any fish, although this is the age of fishes. They have been found in the southwestern portion of Indiana, and in some parts of Ohio; but as yet, I have not been able to find any in this locality. Passing along upward we leave the Devonian, and reach the

CARBONIFEROUS AGE.—In the southern part of Indiana, this is well represented in the extensive coal fields which abound there. We have no coal, that is brought to the surface at least. But in the Sub-Carboniferous Period, we have several fossils, among the most predominant, the Spirifernia octoplicata and Spirifer bisulcatus, are found. Geodes of the Keokuk group are occasionally met with. Some of these are very fine specimens. They are not as large, however, as are found in some sections of the country, particularly Missouri. Before leaving the Carboniferous age, I will quote from Prof. Steele: "A fearful earth storm swept over the continent; not only twisting and dislocating the horizontal coal-beds, but lifted them above their former level. An evolution of the internal heat accompanied the convulsion; and thus the bituminous coal was metamorphored into anthracite. This effect, like that seen in the rock strata, was most felt near the Atlantic coast; hence we find anthracite coal in the Appalachian mountains, next semi-bituminous, and in the western era, bituminous coal alone." To give the reader an idea of the extent of our western coal fields, in comparison with those of other portions of the United States, and also of foreign countries, I append a statistical account of the "coal area:"

The Appalachian coal field	80,000	square miles.
Indiana, Illinois and Kentucky	50,000	" "
Iowa and Missouri	60,000	" "
The Michigan	15,000	" "
The Great Britain	12,000	" "
Continent of Europe	10,000	" "
Nova Scotia and New Brunswick	7,000	" "
United States more than	200,000	" "

Prof. H. D. Rogers states, approximately, the amount of coal in the most important coal-fields in the world, as follows:

Belgium	36,000,000,000	tons.
France	59,000,000,000	"
British Isles	190,000,000,000	"
Pennsylvania	316,400,000,000	"
Appalachian	1,277,500,000,000	"
Indiana, Illinois and Kentucky	1,277,500,000,000	"
Iowa, Missouri and Arkansas	739.000,000,000	"
Total amount in North America	4,000,000,000,000	"

It will be seen that Indiana, Illinois and Kentucky, in their geological formation, contain not much less than the Appalachian coal-fields. This speaks well for our fuel in the future. "In some parts of the world they are beginning to calculate how long their supplies of coal will last. In England not less than 6,000,000 tons of coal are yearly raised from the mines of Northumberland and Durham; at which rate they will be exhausted in about 250 years. In South Wales, however, is a coal-field of 1,200 square miles, with 23 beds, whose total thickness is 95 feet; this will supply coal for 2,000 more. Here, in North America, we have 21 times as much coal as Great Britain. Estimating our annual consumption of coal at twelve million of tons, there is coal enough in North America to last three hundred and thirty-three thousand three hundred and thirty-three years." It is estimated, approximately, that the annual consumption of coal in the whole world is one hundred millions of tons. With such prospects for fuel, we need not be alarmed that wood is becoming scarce, for there is enough fuel and to spare, under the ground; it only needs the application of man's inventive powers to bring it to the surface, and it is ready for use, without much further trouble.

I have already drawn my descriptions to a much greater length than I intended; for which, I hope my readers will pardon me. In my next article I will endeavor to present the features of the succeeding periods as they were developed; closing with a description of the recent period, giving the "Fauna and Flora," minerals, &c. I have been prompted to write for the purpose of satisfying myself concerning a matter over which a strange mystery broods. In correspondence with the Assistant State Geologist, on the geology of Lagrange county, he says: "If any wells in your vicinity have been lowered to the rock, please inform me what formation was passed through, as I would like to ascertain

more definitely regarding the formation." In speaking of the fossils of Van Buren township, I said that it was volcanic action that brought these remains of Silurian and Devonian seas to the surface (?) and that is my opinion now, notwithstanding professors, principals of schools, etc., claim that they were brought in and through the agency of the drift period. Will our geological readers assist me in solving the problem, and in so doing confer a favor on an investigator and lover of Geology ?

SCIENTIFIC MISCELLANY.

PROFESSOR MORTON ON THE ELECTRIC LIGHT.

In a lecture before a meeting of the American Gas Light Association, at Stevens Institute, Hoboken, October 17, Professor Morton reviewed the progress made in producing light by electricity, and discussed at some length the question of competition between electricity and gas. In tracing the history of the electric light he said that it is, as applied to practical purposes, essentially a phenomenon of magneto-electricity, or the mechanical production of electricity, because electricity produced by the battery is only used as a matter of scientific interest. In this sense the possibilities of the usefulness of the electric light originated with Faraday's discovery of magneto-electricity in 1831, as everybody knows. This was followed within a year or two by the invention and construction of magneto-electric machines by Saxton, Clark and others, and these were developed in size and power by Holmes, and by the various inventors whose work is embodied in the machine known as that of the Alliance Company, in Paris, a machine capable of producing a very brilliant electric light, but very bulky and very expensive, requiring immense power to drive it. Its use was consequently limited to the Falmouth lighthouse, in England, and to some French lighthouses and works of construction like the Cherbourg docks.

The first decided improvement upon this machine was made by Siemens, who devised a peculiar form of armature. The next step forward was made by Mr. Wild, of England, who made the remarkable discovery that if a current from a small magneto-electrical machine was made to pass around the coils of a large magnet, the attractive power of that magnet would be immensely greater than the force of the magnets in a small machine. Thus by working a small machine, passing the currents through electro-magnets of a large one, and then taking from the armature of the large machine the current to be used, he obtained great electric power in a small compass. Almost at the same time Wheatstone and Siemens made similar improvements, and a machine, between them and Ladd, of London, received another development by having this curious combination introduced. A single set of electro-magnets were employed, with an armature between

the poles wound with two coils, one coil being so connected as to pass the current through the electro-magnet itself, and the other supplying a current for exterior use. In this way the machine, as it were, excited itself, and then yielded a powerful current for exterior work.

In all the machines used, up to this time, the armature had its magnetism reversed as it rotated, and this involved a great loss and waste of power. The French cabinet-maker, Gramme, conceived the idea of using a ring and rotating this ring between the poles of a magnet in such a way that there should be no reversal of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with poles from which the induced current was taken. The idea here involved was so unpromising that several electricians wrote very decidedly concerning it, opposing and ridiculing it. Nevertheless it produced in practice a machine which possessed a remarkable merit in yielding a large quantity of electricity with a very small expenditure of power. In this country, Mr. Palmer, of Boston; Mr. Wallace, of Ansonia; Mr. Brush, of Cincinnati; Mr. Weston, of Newark; and Mr. Hockhausen, of New York, have all developed machines which involve some of the general principles contained in the earlier productions, and all of which are excellent in their way. By one or other of these machines we are now enabled to produce light by an expenditure of power so small as to render its production cheap; probably not far from a fair average is that of 1,000 candles per horse power. Consequently this light has opened to it a wide field of usefulness and practical application which did not exist when it was more expensive.

Touching the practical uses of the electric light, Professor Morton said that the illuminating of large workshops, of public buildings, places of amusement, gardens, and the like, is undoubtedly an accomplished fact, and this use of the electric light, we feel confident, will largely extend. But it has been suggested that more than this will soon be reached, and that the electric light will take the place of other sources of illumination, gas, for example, in private houses. It would be very foolish for any one to attempt to predict what may or may not be accomplished in the future, but in such a case as this we may at least look back at the past and see what has been the history of the same thing, and judge something of future probabilities from past experiences.

Thereupon the speaker described at length the unfulfilled promises of Mr. Jobart's method of dividing the electric light, which twenty years ago was thought to have solved the great problem of electric lighting. He would by no means have it inferred that better success could never be attained. On the contrary, there are several very promising directions for experiment, on one of which, no doubt, Mr. Edison is at present embarked; but the difference between a promising line of experiment and a successful result all the world's history teaches us, is often a distance of many years, to say the least.

The method of producing light by heating a platinum wire by the electric current was then exhibited and explained, and its difficulties enlarged upon. Also the production of light in Geissler tubes, and by the extra current as em-

ployed by Professors Houston and Thomson, of Philadelphia, in which direction he thought something might be attained. Of the speedy substitution of the electric light for the gas light, Professor Morton was very skeptical; no such radical change as many expect, need be expected this century.

An interesting feature of this lecture was the exhibition of an improved gas burner giving a light of 250 candles with the consumption of forty cubic feet of gas an hour.—*Scien. Amer.*

THE MOST ANCIENT LAND SURVEY IN THE WORLD.

Discoveries recently made at the British Museum among the cuneiform inscriptions on the terra-cotta tablets of ancient Babylon render it questionable whether the Babylonians should not have at least equal credit with the Egyptians for the discovery of the science of geometry, and of its application to land-surveying and the delineation of lands.

The number of documents (that is, terra cotta tablets) which the Museum now possesses in relation to the commercial and land transaction of ancient Babylon and Assyria is very great, a collection of more than 2,000 having been purchased at Bagdad in 1875.

There are many interesting facts as to the daily life of the ancient people to be gathered from them, but that which it is our present purpose only to notice is the tablet which contains, not simply a description, but an actual *plan* of the land referred to in the document, just as plans are now drawn on parchment in the margin of leases. This, we think we may safely say, is at present the oldest known land-survey in the world. It is drawn on a tablet in dark terra cotta, about 6 inches by 3¼ inches and represents a plot of land about 8½ acres in area. The inscription at the top informs us that it is the plan of "A field in the high road on the banks of the river or canal," Nahr Banituv. The name of the river, however, is obliterated, and its place has been supplied by Mr. Boscawen from information drawn from other tablets relating to adjoining property. The estate is divided into three pairs of parallelograms, to which are added two more similar-shaped plots, and an irregular trapezoidal piece. The dimensions are all given in cubits, or fractions of cubits, most carefully figured on the drawing. Taking the Babylonian cubit as 20.475 English inches, the greatest length of the estate would be, from north to south, 1,646 cubits, or 936 yards 0 feet 5 inches English. The width on the northern border on the edge of the highway is 84 cubits=140 feet. The dimensions on the southern part being much defaced, it is difficult to ascertain the length of the base line. On the east side the curve is most carefully measured, its circumference being 120 cubits, or 200 feet. A small dimension has been marked in the interior of the arc, which evidently represented its radius, but it is unfortunately obliterated. The northern boundary is the highway, or, as it is called in another document, "the royal highway." (It is interesting to notice such a very ancient use of our present common phrase,

"the king's highway.") The western side adjoins the lands of Ipriya and Buruga, the son of Taria, the son of the Chief Builder, and this latter person is the owner also of the land on the southern boundary. The eastern side and the upper portion adjoin the lands of Nabusar-ibni, and another portion adjoins the lands of Kasiya, the son of Dibzir, the son of Pitu-sar-babi. It would seem strange for a modern surveyor to mark upon his plan, not only the names of his client's neighbors, but those of his fathers and grandfathers, yet this practice has revealed to us the fact that the ancient Babylonian "Chief Builder," or architect, was a person of some consequence, who left lands behind him, and grandchildren to be proud of their descent from him; and not the serf, or servant, which he was mistakenly represented to be in one famous modern picture.

As an example of the system of mensuration, and curious method of computation of the area, which was according to the amount of corn seed required to sow it, we make the following extract from a tablet dated in the third year of Nabonidus, king of Babylon:

1. 949 cubits on the upper side toward the west a boundary is fixed.
2. By [the land of] Nabu-sum-utsir, the giver of the field.
3. 949 cubits on the lower side toward the east the boundary is fixed by the land of Nabu-sar-ibni, son of Marducu.
4. 40 cubits the upper headland, a boundary line is fixed by the king's highway on the bank of the canal of Banituv.
5. 40 cubits the upper headland, a boundary is fixed by the other portion of the field.
6. For this field, and this portion, five measures of corn seed. A field with the wells attached
7. A valuation of 5 epha., 8 measures of corn seed.

This is the first measurement.

This represents the measurement and sowing area of the first portion of the land sold in the tablet. A second portion which joins on to the southern border, is also computed by a similar arrangement. A summary of the two results is given, and the price in silver, according to the market value of corn, is computed and entered as the price of the land. A guarantee of about one-tenth per cent. is required and given as security for the fulfillment of the clauses of the deed. The names of seven witnesses who attest the deed, by affixing their *nail-marks*, and the scribes, who append their seals, testify to the legal character of the document.

Such was the legal procedure in the conveyance of land 2,500 years ago in ancient Babylonia. How little it differs from the legal acts and deeds which are daily transacted in our modern Babylon of London and in this Great Britain which has just assumed new responsibilities in relation to the old country whence these antiquities have been exhumed!—*Building News*.

Mould in Cellars.—A German agricultural journal gives the following: Put some roll brimstone into a pan and set fire to it; close the doors, making the cellar as nearly air-tight as possible for two or three hours, when the fungi will be destroyed and the mould dried up. Repeat this simple and inexpensive operation every two or three months, and you will have your cellar free from all parasitical growth.—*Boston Journal of Chemistry*.

EYES OF FLOUNDERS.

How the eyes of the flounder become situated both on the same side of the head is discussed by Mr. Agassiz in the Proceedings of the American Academy of Arts and Sciences. The young flounder immediately after hatching does not differ from other fishes, but very early in life, as is seen in eight species, one eye begins to pass, by a combined process of translation and rotation, over the frontal bones from the pale side to the dark side. In *Plagusia*, however, the eye sinks into the head, the old orbit closes up as the eye works its way across the head of the *Plagusia*, until eventually the right eye gets entirely over to the left side. Pouchet has recently called attention to the fact that the want of color on the blind side of flounders is plainly due to the partial atrophy of the great sympathetic nerve, effected during the passage of the eye from one side of the head to the other.—EDITOR'S SCIENTIFIC RECORD, in *Harper's Magazine for October.*

SIMPLE TESTS OF WATER.

The complete analysis of potable water requires much chemical skill, but the more common impurities may be detected by comparatively simple tests. Certain deleterious salts may thus be recognized. Among these are the nitrates, whose presence is chiefly significant as showing that organic matter has been acted upon and *may be present.* The danger is not in the salts themselves but in their source, which should, if possible, be ascertained. To examine water for nitrates, put a small quantity of it in a test tube; add an equal quantity of pure sulphuric acid, using care so that the fluids shall not mix; to this add carefully a few drops of a saturated solution of sulphate of iron. The stratum where the two fluids meet will, if nitric acid be present, show a purple, afterwards a brown color. If the nitric acid be in minute quantities, a reddish color will result. The presence of ammonia, if in excess, can be determined by treating the water with a small quantity of potassic hydrate. Ammonia, if present, will be liberated and may be recognized by its odor, or by the white fumes of chloride of ammonium when a glass rod wet with muriatic acid is passed over the mouth of the test tube. If chlorine is present in any form in water used for drinking, it is evidence that sewage contamination in some form exists. The presence and amount of chlorine may be ascertained by the following simple method: Take 9 grains of nitrate of silver, chemically pure, and dissolve it in 200 units (say, cubic centimetres) of distilled water. One unit of the solution will represent 1–100th of a grain of chlorine. Take a small measured quantity of water to be examined, and put into a glass vessel more than large enough to hold it. Add to the water a *small* quantity of the solution; if chlorine be present, a white precipitate will result. Repeat the addition, after short intervals, until no precipitate results. The units of the solution used will determine the hundredths of a grain of chlorine present. If more than a grain of chlorine in a gallon be present, reject the water, unless it can be clearly determined that the excess does not come from sewage. The water should be slightly acidulated with nitric acid before the test is applied.

Several years ago we described and commended Heisch's sugar test for the presence of dangerous organic matter, but it is worth repeating in this connection, being at once simple and trustworthy. Place a quantity of the water in a clean, glass-stoppered bottle; add a few grains of pure sugar and expose to the light in a window of a warm room. If the water becomes turbid even after exposure for a week, reject it; if it remains clear it is safe.—*Boston Journal of Chemistry.*

A STORY OF SCIENCE.

BY ONE WHO KNOWS NOTHING ABOUT IT.

A philosopher sat in his easy chair,
  Looking as grave as Milton;
He wore a solemn and mystic air
  As he Canada balsam spilt on
A strip of glass, as a slide to prepare
  For a mite taken out of his Stilton.

He took his microscope out of his case,
  And settled the focus rightly:
The light thrown back from the mirror's face
  Came glimmering upward brightly.
He put the slide with the mite in place,
  And fixed on the cover tightly.

He turned the instrument up and down,
  Till getting a proper sight, he
Exclaimed—as he gazed with a puzzled frown—
  "Good gracious!" and "Highty-tighty!
The sight is enough to alarm the town—
  A mite is a monster mighty!"

From t'other end of the tube, the mite
  Regarded our scientific,—
To its naked eye, as you'll guess, the sight
  Of a man was most terrific,
But reversing the microscope, made him quite
  The opposite of magnific.

"One sees the truth through this tube so tall,"
  Said the mite as he squinted through it,
"Man is not so wondrously big after all,
  If the mite-world only knew it!"

MORAL.

Mem.—Whether a thing is large or small
  Depends on the way you view it!

Fun.

EDITORIAL NOTES.

The articles in this number by Rev. James French and Dr. Heath, were read at recent meetings of the Kansas City Academy of Science, while that by Prof. F. H. Snow was read before the Kansas State Academy of Science at Topeka last month.

Dr. Heath has returned to Peru, and it is a pleasure to be able to state that he will, from time to time, contribute articles to the Review from that interesting country.

Prof. Ward, of Rochester, made us a brief call on the 9th inst. He is visiting the West in search of Archæological specimens for his Museum.

Sir Wyville Thomson has divided out the labor of working up the collections made by the *Challenger* Expedition, without regard to the nationality of the naturalists selected, and has been fortunate enough to secure the assistance, in this country, of Professors Alexander Agassiz and Theodore Lyman, in elaborating the *Radiates*, the former having charge of the *Echinidæ*, and the latter of the *Ophiuridæ* and the *Astrophytidæ*. This action has brought forth some criticism, but Sir Wyville contends that his duty requires of him to furnish the best possible reports on the various subject of inquiry, and that science knows no nationality.

New Exchanges.—Since our last issue we have been favored with the following new exchanges, viz: *The American Quarterly Microscopical Journal*, a very handsome octavo of 82 pages, edited by Prof. Romyn Hitchcock, fully illustrated, published by Hitchcock & Wall, New York, at $3.00 per annum; *The Science News*, published fortnightly by S. E. Cassino, Salem, Mass. It is devoted especially to "the prompt publication of scientific news," and is edited by Ernest Ingersoll and Wm. C. Wyckoff, of New York. 16 pp. octavo, $2.00 per annum; *The University Courier*, published monthly by an organization of students of the Kansas University at Lawrence, Kansas, edited by H. C. Burnett, assisted by several young ladies and gentlemen, among whom we notice the name of R. W. E. Twitchell, of this city. The first number presents a very fine appearance, and contains much valuable matter. Price, 50c per school year. *The American Young Folks*, edited and published by Hudson & Ewing, Topeka, Kansas. This is a well established, first class, youth's paper, well deserving the patronage of the young folks of the West. 16 pp. folio. 50c per annum.

H. W. Bache, of the United States coast survey, died in Bristol on the 7th inst.

Sidney J. Hare, one of our students, has presented a neat case of geological specimens, representing all the strata found in Kansas City from No. 78 to No. 100 of Broadhead's geological survey, for the permanent use of the Central school of this city; accompanying it is an explanatory diagram, both of which are invaluable to the natural science department. On motion of Mr. Switzer, a vote of thanks was extended, by the Board of Education, to Mr. Hare for his excellent donation.

In the hope of gaining a few more subscribers, we make the following offer: To all who will subscribe for the current (Second) volume, beginning with the April, 1878, number, we will give the whole of the First volume for the nominal sum of one dollar, thus making the two volumes, amounting to over 1500 pages, $3.50. This is an excellent opportunity to obtain two voumes of fresh, first-class, popular science at a low price.

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GEOGRAPHY.

CONGRESS AND THE NORTH POLE.

AN ABSTRACT OF ARCTIC LEGISLATION IN THE CONGRESS OF THE UNITED STATES.

BY CAPT. H. W. HOWGATE, U. S. A.

III.

THE RECOVERY OF THE RESOLUTE.

The Recovery of the Resolute and the subsequent official disposition made of her, form an interesting episode in the history of Arctic adventure, the record of which appears to come properly within the scope of these articles.

The British barque Resolute was abandoned May 15th, 1854, in Wellington Inlet, by order of Sir Edward Belcher, and after a drift of over one thousand miles was picked up about the first of September, 1855, near Cape Mercy, by Capt. James Buddington, of the American whaler, "George Henry," and brought to the port of New London, as a prize. The fact of the recovery of the vessel was brought to the attention of the authorities in Washington, and resulted in its purchase by the government and presentation to the British government as an act of high international courtesy. The story is fully told in the official proceedings which follow. It is noteworthy that the first man to board the Resolute from the George Henry, was Capt. Geo. E. Tyson, then serving on the latter vessel as

"boat-steerer," but since identified with the cruise of the Polaris, the extraordinary ice-drift of one hundred and ninety-eight days, and the recent voyage of the Florence, as a member of the Preliminary Arctic Expedition of 1877.

CONGRESSIONAL ACTION.

IN SENATE, June 10, 1856 —Mr. Foster, of Conn., offered a resolution instructing the Committee on Commerce to inquire into the expediency of authorizing the Secretary of the Treasury to issue a register to the British-built barque, "Resolute," found derelict, near Cumberland Inlet, in the Arctic ocean, by the officers and crew of the American whaling ship George Henry, of New London, Conn., and by said salvors brought into the port of New London all claim to said vessel by the British government, having been relinquished to the salvors. Mr. Foster stated that this barque was one of a squadron sent out by the English government to the Arctic ocean in search of Sir John Franklin, and was abandoned by the officers and crew belonging to her, in Wellington Inlet. Eighteen months afterward she was discovered by the "George Henry" imbedded in the ice more than one thousand miles from the place where she was abandoned.

Mr. Mason, of Virginia, suggested that the proper disposition of the vessel would be for the United States to purchase her and refit her in a proper manner and send her back to England as an act of national courtesy. Whereupon Mr. Foster withdrew his resolution.

IN SENATE, June 24, 1856.

Mr. Mason, of Va., introduced a joint resolution authorizing the purchase and restoration to the British government of the ship "Resolute," late of the British Navy. Pending the consideration of the resolution, Mr. Foster, of Conn., said, "in regard to the ship there are certain circumstances that make it of peculiar value to the government of Great Britain. It is the ship that was enabled to communicate with the crew of another ship belonging to the British navy, the Investigator, which went through Behring's strait, intending to make the northwest passage in that direction by sailing to the east, but having got locked in the ice, remained for two years in the bay of Mercy, I believe. While lying there, this ship—the "Resolute"—by sending a party of men across some two hundred miles or thereabouts, communicated with the Investigator and her crew, commanded by Capt. McClure, and brought those men from the Investigator eastward to where the Resolute was lying. The northwest passage was thus carried out practically by these two ships; neither, however, having completed it by passing through the water, but by the men passing through over the ice on sledges." There was no opposition, and the resolution passed unanimously.

IN THE HOUSE OF REPRESENTATIVES, Aug. 27, 1856.

Mr. Clingman called up the Senate resolution, and stating its purport and object, requested its immediate consideration. Mr. Jones called for the yeas and nays, but they were not ordered, and the resolution passed without amendment or debate in the following words:

WHEREAS, It has became known to Congress that the ship "Resolute," late

of the Navy of her Majesty, the Queen of the United Kingdom of Great Britain and Ireland, on service in the Arctic seas, in search of Sir John Franklin and the survivors of the expedition under his command, was rescued and recovered in those seas by the officers and crew of the American whaleship, the "George Henry," after the "Resolute" had been necessarily abandoned in the ice by her officers and crew, and after drifting still in the ice for more than one thousand miles from the place where so abandoned, and that the said ship "Resolute," having been brought to the United States by the salvors at great risk and peril, had been generously relinquished to them by her Majesty's government. Now, in token of the deep interest felt in the United States for the service in which her Majesty's said ship was engaged when thus necessarily abandoned, and of the sense entertained by Congress of the act of her Majesty's government in surrendering said ship to the salvors,

Be it resolved, by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States be, and he is hereby requested, to cause the said ship "Resolute," with all her armament, equipment, and the property on board when she arrived in the United States, and which has been preserved in good condition, to be purchased of her present owners, and that he send the said ship with everything pertaining to her as aforesaid, after being fully equipped at one of the navy-yards of the United States, back to England, under control of the Secretary of the Navy, with a request to her Majesty's government, that the United States may be allowed to restore the said ship "Resolute" to her Majesty's service; and for the purchase of said ship and her appurtenances, as aforesaid, the sum of forty thousand dollars, or so much thereof as may be required, is hereby appropriated, to be paid out of any money in the treasury not otherwise appropriated.

The resolution received the presidential approval on the same date, Aug. 28, 1856, and on the 13th of November, the Resolute, under command of Commander Hartstene, sailed from New York Harbor for England. She arrived at Portsmouth, December 12th, and on the 16th was delivered to the Queen of Great Britain in person.

The following message from the President of the United States, transmitting copies of a correspondence growing out of the restoration of the vessel to her Brittanic Majesty's service, gives a detailed account of the official ceremonies attending the transfer.

January 20, 1857.—Laid upon the table and ordered to be printed.

To the Senate and House of Representatives:

Soon after the close of the last session of Congress, I directed steps to be taken to carry into effect the joint resolution of August 28, 1856, relative to the restoration of the ship "Resolute" to her Brittanic Majesty's service. The ship was purchased of the salvors at the sum appropriated for the purpose, and "after being fully repaired and equipped," was sent to England under control of the Secretary of the Navy. The letter from her Majesty's minister of foreign affairs now communicated to Congress in conformity with his request, and copies

of correspondence from the files of the Departments of State and of the Navy, also transmitted herewith, will apprize you of the manner in which the joint resolution has been fully executed, and show how agreeable the proceeding has been to her Majesty's government.

FRANKLIN PIERCE.

Washington, Jan. 19, 1857.

MR. DALLAS TO MR. MARCY.

(Extract.)

LEGATION OF THE UNITED STATES,
LONDON, December 19, 1856.

SIR: * * * * * * * * * * * *
Late in the morning of Saturday, the 13th inst., your No. 36 was delivered to me by Commander Hartstene, who had that morning arrived with the barque "Resolute" at Portsmouth. I addressed the Earl of Clarendon at once in conformity with your instructions, tendering the ship to the British government with a request that the United States might be allowed to restore her to her Majesty's service. In a private note I also sought an interview with his lordship, in order to arrange whatever formalities the proceeding might require. He was out of town, but on Monday I received a note from him saying he would return to London, and be happy to see me at three o'clock on Tuesday the 16th inst. Our conference was an entirely agreeable one; his lordship characterizing the restoration of the "Resolute" as an act of national courtesy, wholly unprecedented, and which could not fail to have the most beneficial influence upon the relations of the two countries. As I desired to put Capt. Hartstene in communication with the admiralty, I made inquiries about Sir Charles Wood, and was informed by his lordship that he was probably at his country residence, but should be immediately apprized of my wishes, and would, no doubt, come to the city without delay. At about nine o'clock that night (Tuesday) I received the reply of her Majesty's principal Secretary of State for foreign affairs to my offering letter of the 13th. Copies of these communications accompany this despatch * *
* * * * * * * *

I have the honor to be
Your most obedient servant,
G. M. DALLAS.

Hon. W. L. MARCY, Sec. of State.

MR. DALLAS TO THE EARL OF CLARENDON.

LEGATION OF THE UNITED STATES,
LONDON, Dec. 13, 1856.

MY LORD:—The barque Resolute under the command of Commander Hartstene, of the United States Navy, having reached Portsmouth, I beg leave briefly to invoke your lordship's attention to the cause and object of her arrival.

It will be recollected that this vessel formerly belonged to her Majesty's navy, and had been employed on a perilous service which enlisted the co-operative sympathies and exertions of the American government and people. The officers and crew, after gallantly enduring prolonged suffering, left her inextrica-

bly imbedded, as they had just reason to believe, in the ice of the arctic region. She was, however, about two years afterwards, discovered adrift, more than twelve hundred miles from the place at which she had been abandoned, and was taken by certain American seamen to their own country. All claim to recover and repossess her was generously waived by her Majesty's government in favor of those by whom she had been rescued.

The Senate and House of Representatives of the United States in their late session, expressed by a joint resolution, the sincere disposition and purpose of the nation on this subject, and I have the honor to place before your lordship a duly authenticated copy of that act. I am now specially instructed by the President, while conveying to your lordship the assurance of his cordial gratification in directing such a measure of comity to a friendly power, to fulfill the congressional injunction by tendering the barque Resolute to her Majesty's government, and by requesting that the United States may be allowed to restore that vessel, with all her armament, equipment and property, preserved in good condition, to her Majesty's service. Seizing an occasion so agreeable personally, to renew the expression of my highest consideration.

I have the honor to be, your lordship's
Most obedient servant,
G. M. Dallas.

To the Right Hon. Earl of Clarendon.

THE EARL OF CLARENDON TO MR. DALLAS.

Foreign Office, Dec. 17, 1856.

Sir :—I have the honor to acknowledge the receipt of your letter of the 13th inst., announcing to us the arrival of the barque "Resolute" at Portsmouth, under the command of Captain Hartstene of the United States Navy. That after having been unavoidably abandoned in the ice while employed in the service of her Majesty on an expedition in the arctic seas, in search of Sir John Franklin, she was discovered two years afterward adrift, more than twelve hundred miles from the place where she was abandoned and was taken to the United States by American seamen, in whose favor her Majesty's government relinquished all claim to the ship. Under these circumstances the Senate and House of Representatives of the United States, by a joint resolution, of which you transmit to me a certified copy, authorized the President of the United States to purchase the "Resolute" of her salvors, with all her armament, equipment and the property on board of her when she arrived in the United States, and to cause the ship with everything belonging to her, after being fully repaired at one of the Navy yards of the United States, to be sent back to England in order to be restored to her Majesty's service, as a testimony of the deep interest felt in the United States for the service in which the ship was engaged when she was necessarily abandoned.

I have not failed to lay your letter and its enclosures before the Queen, and I have received her Majesty's commands to acquaint you that she gratefully accepts the offer thus made of the restoration of the "Resolute" to her service.

I beg to assure you that the friendly feeling on the part of the Senate and House of Representatives which prompted this measure, and the generous and complete manner in which it has been carried into effect by the President and his government, are most highly appreciated by the Queen and rhe Majesty's government, and I am confident by the British nation at large. I request you, sir, to have the goodness to convey to the President and to request him to communicate to the Legislature of the United States, the cordial thanks of the Queen and of the British government for an act of generosity and the sympathy which will meet with a warm response in this country, and cannot fail to strengthen the kindly feelings which unite the people and governments of the two nations.

I beg to add that the Queen has signified her intention to visit the "Resolute" off Cowes, on this day, in recognition of the munificence of the Legislature and government of the United States in restoring that vessel to her Majesty's service and in compliment to the officers and crew who have brought her to this country. I avail myself of this opportunity to renew to you the assurances of the highest consideration with which I have the honor to be Sir,

Your most obedient humble servant, CLARENDON.

NAVY DEPARTMENT, November 8, 1856.

SIR:—The department has placed you in command of the "Resolute" recently fully repaired and fitted out by the United States with a view to her restoration to the British government, in pursuance of a joint resolution of Congress, approved Aug. 28, 1856. You will, so soon as she is in all respects ready for sea, proceed to England entering the port of Portsmouth. Leaving her there in charge or the officers under your command, you will proceed immediately to London in order to advise with the American minister, Hon. G. M. Dallas, to whom you will deliver the enclosed despatch from the Department of State. Accompanying these instructions you will receive an open communication from this department to Sir Charles Wood, the first lord of the Admiralty, who will, I presume, advise you as to the proper disposition of the ship in the event of her Majesty's government accepting her. You will consult freely with Mr. Dallas and will find it convenient to be guided in your movement by suggestions from one so peculiarly competent as he is.

When you have performed the duty assigned to you, you will make arrangements for the return of the officers and men, exercising all prudence and economy. Previous despatches have instructed you as to the mode of procuring funds to effect your purposes. I am, respectfully, your obedient servant,

J. C. DOBBIN.

Commander H. J. Hartstene, U. S. N.,
Commanding Barque Resolute, New York.

UNITED STATES NAVY DEPARTMENT, Washington, Nov. 8, 1856.

SIR:—This communication will be delivered to you by Commander Henry J. Hartstene, of the United States Navy, who goes to England in command of the "Resolute" under orders from his government with a view to carrying into

execution "a resolution authorizing the purchase and restoration to the British Government of the ship 'Resolute' late of the British Navy", a copy of which I have the honor to enclose herewith.

The language of the preamble and the resolution so distinctly announces the considerations which prompted their adoption and approval as to dispense with their repetition and recital on my part. This very agreeable duty is performed by me, Sir, with much pleasure. The ship has been thoroughly repaired and has on board "all her armament, equipment and property" which has been preserved in good condition. In pursuance of the resolution the President requests to her Majesty's government to allow him to restore the ship "Resolute" to her Majesty's service.

Commander Hartstene is ordered to deliver the vessel at any port and to any officer, to be designated at the pleasure of her Majesty's government.

Accept assurances of high respect, etc. etc.

J. C. Dobbin, Sec. of the Navy.

To the Right Hon. Sir Charles Wood, Bart.
First Lord of her Brittanic Majesty's Admiralty.

London, Dec. 19, 1856.

Sir:—I have the honor to inform you that after a boisterous passage we anchored at Spithead on the 12th inst., at half past two o'clock p. m., with the United States and British ensigns flying at the peak. Notwithstanding the furious gale, which was then raging, we were immediately boarded by Capt. Peale of her Brittanic Majesty's frigate Shannon, who cordially offered to us every civility and attention. In a few moments afterward a steamer arrived from Vice Admiral Sir George Seymour (commanding officer of the station), with a tender of services and congratulations on our safe arrival. Proceeding to Portsmouth next morning (which I did in a government steamer provided me for that purpose) I visited the United States consulate and was there waited upon by Sir Thomas Maitland (who has become commanding officer of the Naval station in the absence of the Admiral Sir George Seymour), and received from him a most cordial welcome with proffers of every possible service. By express instructions from the Admiralty accommodations were prepared for us at the first hotel, and orders for a bountiful supply of provisions to be sent on board the "Resolute", also a carte blanche for the railroad to London, for myself and the officers of the "Resolute." In fact nothing could exceed the kindness and courtesy with which we were treated by Capt. Sir Thomas Maitland, who seemed unwilling that any means of adding to his hearty expressions of welcome should pass unexhausted. That morning's post brought me a communication from Sir Charles Wood, first Lord of the Admiralty, (which I herewith enclose) whose expressions of kindly feeling I beg may be particularly noticed. At noon of the day after our arrival, a royal salute was fired from the "Victory" (flagship), from the fortifications and from the "Shannon" at Spithead. As soon as my official visits were made, I proceeded to London and delivered to the Hon. Mr. Dallas, Minister plenipotentiary and envoy extraordinary from the United States, the open communication committed to my

charge by the department. In London as well as in Portsmouth, I received the most cordial and pressing hospitalities; in fact scarcely an hour has elapsed without a proffer of courtesy and hospitality from the municipal corporations, military authorities, scientific associations, clubs, etc., etc., all of which I have politely declined, except an invitation to dine with Lord Palmerston, also one from Admiral Sir George Seymour and one from the municipal authorities at Portsmouth.

Her Majesty and Queen expressing a wish to visit the "Resolute" and a desire that that vessel might be taken to Cowes (near her Majesty's private palace), I immediately acceded, and the ship was towed thither by the government steamer, escorted by two other steamers and her Brittanic Majesty's steam-frigate "Retribution." On the morning of the 16th at ten o'clock a. m., her Majesty the Queen, accompanied by his Royal Highness Prince Albert, the Prince of Wales, the Princess Royal, Princess Alice and several members of the Royal household, visited the "Resolute." She was received with all honors. As her Majesty stepped on board, after being presented by Vice Admiral Sir George Seymour, K. C. B., I welcomed her, and from the impulse of the moment and in obedience to what I conceived to be of the feelings of my countrymen, I delivered the "Resolute" to her Majesty, after which I showed her Majesty all the objects of interest, connected with the vessel, with which she appeared much gratified.

On the afternoon of the same day I received from the Hon. C. B. Phipps, C. B. (keeper of her Majesty's privy purse) a note enclosing a check for £100 (one hundred pounds), with a request from her Majesty that it should be distributed among the crew, which I accepted in their behalf. I enclose the note, also a letter from the Admiral Sir George Seymour, K. C. B.

By favor of an invitation from her Majesty the Queen, I dined and spent the night at the palace of her Majesty at Osborne, where I was treated with the most distinguished attention. On the following morning (Dec. 17), the "Resolute" was towed up to the harbor of Portsmouth, escorted by her Majesty's steam-frigate "Retribution," and on arriving at her anchorage was received by another royal salute and with such an outburst of popular feeling as was never known before.

I have this day received from Sir Charles Wood, first lord of the Admiralty, an invitation (herewith enclosed) which could not be declined. I have accepted it and shall, as soon as it is agreeable to her Britannic Majesty's government, deliver up the "Resolute" and take advantage of their courteous tender of a passage to the United States. Respectfully, &c.,

H. J. Hartstene, Commander U. S. N.

Hon. J. C. Dobbin, Secretary U. S. Navy,

Washington, D. C,

Admiralty, Dec. 12, 1856.

Sir:—I have this moment heard by telegraph that the "Resolu e," which the government of the United States has in a manner so gratifying to the feelings of this country, sent over under your command, is entering Portsmouth. I hasten to assure you of the satisfaction with which I have learned of your arrival in this

country and of my anxiety to offer to yourself, your officers and crew the warmest reception in my power.

Capt. Sir Thomas Maitland, the senior officer at Portsmouth in the accidental absence of the two admirals, will, I am assured, do everything in his power to show the spirit in which we are most anxious that you should be welcomed, and when we are apprized of your wishes and intentions as to your stay in this country and return to America, we shall be happy to meet them to the utmost.

This is not a fitting opportunity for saying anything as to the munificent conduct of your government, which will be the subject of communication between the governments of our respective countries. I am wishful at present to offer to yourself and your companions, personally every civility and courtesy that the Board of Admiralty can command.

I have the honor to be, sir, your obedient and faithful servant,

CHARLES WOOD.

CAPT. HARTSTENE.

OSBORNE, Dec. 16, 1856.

MY DEAR SIR:—I have received the command of her Majesty the Queen to request that you will have the goodness to distribute amongst the ship's company, who have brought the "Resolute" to England, a hundred pounds, for which I beg to enclose a check.

Her Majesty would wish this to be considered as a personal present from herself to the crew, and I am directed to request that you will use your own discretion as to the proportions in which it is to be distributed.

I have the honor to be, my dear sir, faithfully yours,

C. B. PHIPPS.

(PRIVATE.)

ADMIRALTY HOTEL, PORTSMOUTH, Dec. 17, 1856.

MY DEAR SIR:—I have received a note from Lord Palmerston from Broadlands, his country residence, beyond Southampton, in which he says that he does not know how long you remain at Portsmouth, but if during your stay you will come over with me and dine at Broadlands, it will give Lord Palmerston great pleasure to receive us.

Will you have the kindness to enable me to reply to this invitation to-day about five o'clock, or before six.

I think you will find the visit our prime minister proposes, an agreeable manner of making his lordship's acquaintance, and if you can name a day for the purpose I shall be happy to accompany you. We can go by the railway from Portsmouth to Romsey, which is very near Broadlands.

I have received no direction about the arrangement for the transfer of the "Resolute," but I am disposed to think that less ceremony may be requisite hereafter, her Majesty's visit having conveyed a national compliment on the manner in which the vessel has been restored to this country by the United States.

I remain, dear sir, your very obedient servant,

CAPT. HARTSTENE, U. S. N. G. H. SEYMOUR.

ADMIRALTY, Dec. 18, 1856.

DEAR SIR:—I have the honor to acknowledge the receipt of your letter of this day's date, informing me of the Resolute's being in Portsmouth harbor. I have also received the letter from the Secretary of the Navy of the United States, communicating to me the resolution of Congress, in pursuance of which the Government of the United States has so liberally presented that ship to her Majesty, and sent her over to this country under your command.

I shall have the honor of addressing the Secretary of the Navy in acknowledgment of his letter.

You are good enough to say that you are ready to deliver the Resolute in any manner which may be deemed advisable, and I have only to say that orders will be given to Vice-Admiral Sir George Seymour, the commander in chief at Portsmouth, to make such arrangements for receiving her as may be most convenient to yourself, your officers and crew. It will probably render the arrangement more suitable to your wishes if you would have the goodness to communicate with him on the subject.

I have also to propose to you, that you should return to the United States in one of her majesty's ships, which I shall be ready to order on this service whenever it suits your convenience to leave this counrry, if you accept my offer. I am anxious to show by every means in my power, the sense we entertain of the generous conduct of your Government, and to offer every courtesy to yourself, officers and crew. I am anxious, also, that we should endeavor to promote the good and friendly feeling between this country and the United States, to which, on all occasions, the conduct of the Naval officers of both countries has so much contributed.

The frigate in which I propose to convey you to any point in the United States which you prefer, is ready for sea and would only require filling up with coal, but will, of course, wait for any time you may wish to spend in this country.

I have the honor to be, dear sir, your obedient and faithful servant,

CHARLES WOOD.

CAPT. HARTSTENE, U. S. N.

The following resolution allowing Commander Hartstene, Lieut. S. D. Frenchard, Master Morrison and the petty officers and crew of the steamer Vixen, to accept certain tokens of acknowledgment from the Government of Great Britain, passed both Houses of Congress, and was approved by the President, March 3d, 1857:

Resolved. By the Senate and House of Representatives of the United States of America, in Congress assembled, That Congress consents that Commander Henry Hartstene, of the United States Navy, may accept from the Government of Great Britain, a sword which has been forwarded to the Navy Department by the said Government for presentation to said Commander Hartstene, with the expression of a hope that he may be permitted to receive it as a memorial of the gratification which her Majesty, the Queen of Great Britain, has received from the return of the barque Resolute, of which said Hartstene was commander.

POLITICAL ECONOMY.

CITIZENSHIP AND ITS OBLIGATIONS.*

BY J. V. C. KARNES, KANSAS CITY.

This is an age of radicalism. All modern philosophy, whether physical or social, is intensely analytical. It is believed that every atom of matter, animate or inanimate, is the subject of inflexible government. And to ascertain and enunciate this harmonious and beautiful system of laws, is considered not only a legitimate subject of inquiry, but is claiming the attention of the best thought of modern society. Under such auspices the scientist is unfolding the mysteries of nature, and the analysis has been continued until the speculative mind has ventured the opinion that it can be carried on indefinitely, and that element after element may be evolved, constantly approaching that end where the creative will only will remain.

The sociologist has recognized in man the possibilities of a perfect being, that this is the law of his nature, and that all true progress is toward this high estate. In science it may incline toward transcendentalism, and in society may appear Utopian, but such is the direction of modern thought. Preconceived theories and speculations can offer no resistance. All creeds and philosophies and systems must submit to its crucial tests. No theological dogmas, political or social doctrines can resist its progress. Despite all fulminations the world moves. The orbit of the human mind is ever enlarging, receiving a constantly accelerated force from the recorded wisdom of the past, and only its own Creator can predict the end of its flight.

Amid such intellectual activity there has been found no more interesting field of inquiry than ourselves, individually, socially and politically considered. Men everywhere are thinking of themselves; what they are, and what they ought to be. The eye is inverted, the race is being objectively studied. Whatever may be the cause, it is a recognized fact that modern thought, political and social, as well as physical, is taking a new channel. In some way new ideas are disturbing the conservative forces of society. Men are inclined to disregard all the inculcations of experience, and to enter upon an era of uncertainty. As such subjects are so extensively engaging the public attention, it becomes a matter of duty to give earnest thought to them, and to learn more of them. Acting upon this idea it has been considered that something could be said upon the subject of citizenship, not inappropriate to this occasion. Even the limited discussion of the matter contemplated seems to require first some reference to the theory of government, and especially of our own.

*Delivered before the Alumni of Missouri University, June 4, 1878.

Society and government are not synonymous terms, although the former, in the present imperfect condition of the race, can not exist without the latter. Not to live in society is disintegration and barbarism and ultimate extinction. As has been well said, "it is in society that man first feels what he is, first becomes what he can be. In society an altogether new set of spiritual activities are evolved in him, and the old immeasurably quickened and strengthened. Society is the genial element wherein his nature first lives and grows. The solitary man were but a small portion of himself, and must continue forever folded, stunted and only half alive." But society is not a voluntary association. The social compact, so-called, is a misnomer. The great writers have often spoken of civil liberty as contradistinguished from natural liberty, assuming that there was a surrender of certain rights when the individual abandoned his condition of isolation and became a member of society. But the better doctrine is now taught that society is coeval with the human family, and the adoption of any other theory involves the supposition that there was a time when moral consciousness did not exist and men lived only as other animals, and as no one has any right to be a brute, or anything but a man, so he has no right to abjure society and lead a solitary life. Then, in the consideration of matters of this kind, it is not to be assumed that men institute society; they compose it only. This community of persons, in prescribed limits, as our civilization extends, constitute the State; as has been forcibly expressed, "the vital articulation of many individuals into a new collective individual." The society, the community, the State, cannot exist without law, and this is the initial point in the study of government. Shall the rule of action for the guidance of all be enunciated by those subject to it; shall it be self-prescribed and imposed, or shall it emanate from some source without and above? These are exactly opposite theories, and based upon opposite conclusions of human capabilities. The one is founded on the idea of individual intelligence and responsibility, that every one can of his own volition bring himself within the limitations prescribed, that he is capable of self-government; the other regards him in his animal relations, that he is insubordinate, and must be restrained by an authority foreign to himself. It does not follow that good or bad government is the necessary result of either plan. The individuals might adopt a law most vicious and destructive, while from a source remote from themselves there could exist an administration most wise and beneficent. Hence it is that of the advantages of the two systems, nothing can be definitely determined merely by historical comparisons. We know that one is based on confidence, the other on distrust, and it only displays an ignorance of our own nature to suppose this struggle for liberation will ever cease. Often in an exuberance of patriotic enthusiasm or of depression, men are heard to say that if their favorite star should disappear from the political firmament none other would ever arise and such would be the last effort at free-government. This is now considered as only rhetorical fancy. Studying the race through its successive developments, the existence of government arising from without is entirely natural. As it began to emerge from primitive conditions, as some possessed more native cun-

ning or brute force than others, they would make claim by virtue of their inherent power to the right to rule, the principle of hero-worship drew the inferior around them, and amid this adoration the way was easy to make claim of divine right. An authority thus once established constantly fortifies itself; sometimes by wise laws and beneficent rule, with an intensated, consecrated sort of loyalty, or more frequently by the most rigid exactions of absolutism. But whatever may be the result, the relation is servile. Whether the master be kind or cruel, the single duty of the slave is perfect obedience.

The struggle everywhere, in every age, has always been toward emancipation from this thralldom. No people ever adopted a monarchy, but such is always assumed and maintained. No people ever went voluntarily into bondage. The other idea, that of democracy, is a growth, or rather a revolution, a dethronement of the false gods who had claimed divine authority, and an assertion by the State that it can take care of itself. In the darkness men are willing to be led, but with the first dawn of civilization they struggle for freedom. As the animal is subdued and the intellect developed, each individual begins to become conscious of his power to conform to law, and just so soon he grows impatient of any restraint except that of his own choosing.

Looking back upon the past and out upon the world of to-day, we see on every mountain top, lighted up by the rays of an advancing civilization, that this contest is going on. Democracy, then, is a forward movement, a step upon a higher plane, bringing every individual into immediate relations with the Source of all Power, and making him individually responsible for his conduct. Whatever may be the failures, this struggle will continue to the end of time. The nineteenth century seems to be selected as the great battle field. The railroad and telegraph, the press and school, are dissipating the shadows of superstition, and in their focal light the people are slowly but surely awaking to a realization of their situation. Every out-post of feudalism is surrendering to their demands, and they are now threatening to lay siege to that very citadel of error and wrong, the Divine Right of kings.

So steadily and persistently has this transformation gone on that to-day England, though imbedded in conservatism,

> " Where Freedom broadens slowly down
> From precedent to precedent,"

is only technically a monarchy, and the voice of the people is echoed through every part of her vast dominions. Imperial rule in France has been broken, and the people, amid much confusion, are taking their first steps in self-government. They are learning that they are not dependent for their national existence upon any Bourbon house or Napoleonic dynasty, but that they have an inherent force by which they can make and unmake kings at their pleasure. In the long contest throughout Europe between the democratic tendencies of the age and the hereditary right of kings, Russia has been the chief support of the latter; but even here Absolutism has been checked. In the slow but steady growth of the people, the nobility were reaching their giant arms to displace even royalty itself,

and to weaken them—to level the masses and widen the distance between the crown and the subject—Alexander was driven for temporary relief to his famous expedient of emancipation. Sardinia made the first move in Italian liberation in 1849, and so rapid was the spread of the sentiment of free government, that in little more than a decade all Italy enlisted under the banner of Victor Emanuel, and with twenty millions of voices joined in the grand anthem of Universal Liberty. Even the Castilian is awaking from his dreams of pleasure as he sees his own beautiful skies lighted with the lurid glare from the volcanic fires of revolution.

The storm cloud to-day hovers over all Europe, ready to burst at any moment. Restlessness is manifest everywhere. With every shock of arms chains drop from the limbs of some enslaved people. Everywhere, in all countries, and under all conditions, the struggle is the same. To claim that any failure will prevent a repetition of the effort, only demonstrates a failure to appreciate the reasons constantly leading to these efforts. It is simply an order of growth, a devel opment, and sometime in the future all nations will become democratic or perish in the struggle.

Our own government is the only political fabric ever constructed absolutely on the democratic idea. Educated in the strict conceptions of rank and caste, the founders of the Republic threw aside all artificial distinctions forever, and declared all men equal. The historian has said that "Not Cromwell and Hampden, not the Plebeians of Rome and the Demos of Athens, not the Republicans of Venice, nor the Calvinists of Holland or Geneva had ventured upon that tremendous stride in human progress that would alone satisfy the reformers of America." It scarcely seems probable that they were fully conscious of the immense change which their action contemplated. They asserted, unconditionally, the absolute equality of all men, the sovereignty of the people and the existence of inalienable rights, and that to secure these government is established. These doctrines, "the most heterodox of all theories to European reasons, the plainest contradictions to all the experiences of human history, they set forth distinctly and never wavered in their defense." Nothing like this had ever been known before. All other nations have gravitated toward the democratic idea, were institutional in their character, but the projectors of this new enterprise formally adopted it as the corner stone of their national edifice, an artificial result of a political theory. Well might the author of such inspired teachings be designated as the Apostle of Democracy.

From the beginning there has been a full comprehension of the philosophical idea of our system. The principle has always been understood, that the legal and political equality of man was not inconsistent with the utmost variety of natural and social distinctions, and there has been no confusion in thinking minds between the Democracy of laws and the Democracy of sentiment and of manners. Around this central idea our government has revolved through a century, ignoring birth, race, property, rank, caste or other like condition, but recognizing the full, entire, complete equality, before the law, of all men. These premises were of

such a character that there could be but one conclusion. If all were equal no one had any right to usurp the prerogative of another and thereby undertake to represent him. The law was the voice of all, and the officers selected to administer were the agents of all. This was a complete renunciation of the doctrine of government from without. The individual derived his right to participate in the affairs of the commonwealth, not from the condescension of the Crown, but from his birthright as a freeman. No political leader, whatever may be his ability or virtue, has ever attained or can ever attain any enduring fame unless he thoroughly understands and appreciates this living force in our government.

As the teachings of Christ comprehend all ethics, so the doctrines upon which this Republic was founded constitute a complete political code, and all progress that we make as a nation will be in a more strict conformity to them. We hold that all law emanates from the people, that it is simply the expression of their will, that they declare it as a rule of action, and hence we fairly conclude that all who are amenable to the law ought to be heard in its enactment. Following this process of reasoning, every move made is in the direction of enlarging the suffrage, and in following to its legitimate consequences the theory of our system. The Constitution, *as it is*, embraces in its citizenship all persons born or naturalized in the country. With every change in our naturalization laws the time of pupilage required of the foreigner has been shortened. It may be heresy to say it, but under the present educational stimulus the intellectual forces of the gentler sex cannot be much longer suppressed, and woman's voice will soon be heard either through the Sixteenth or some future amendment. We may shut our eyes to this incoming tide, but the law of our national existence will lead to this result as inevitably as the rising of the morrow's sun.

Our basis of citizenship is now much broader than in any other democracy ever attempted. The relation of the voters to the entire population is about one to five or six. In the Athenian republic, the most democratic of the Greek states, at the time when the suffrage was the most extended, there were but 21,000 persons entitled to vote out of a total population of more than 500,000, or about one in twenty-four. Sparta was still more undemocratic than Athens. The number of voters in Laconia, at the time of the Persian wars, according to Herodotus, was only 8,000, while the number of free citizens who were rigidly excluded from political power is computed to have been 16,000, exclusive of women, children and slaves. In the early part of the first century before Christ, while the Roman commonwealth was in the full height of success, when the people triumphed over the Optimates, the whole number of citizens was only 46,300, which was probably about one-fiftieth of the population of that period. In the republics, so-called, of Geneva and Venice, in the hour of the completest triumph of the Guelphs, suffrage was only a privilege dispensed to or claimed by the few for the benefit of the many. In England, even under the fierce agitation of the last quarter of a century, with Arch, and Cobden, and Bright, and Gladstone, and many other noble philanthropists, urging them forward, the people slowly extricate themselves, and even now only about one in twenty is, in any true

sense, a free man. Though France has tired of imperialism, and is enjoying the name at least of a republic, still, there is everywhere manifested a lurking distrust of the democratic principle, and the ballot box, instead of being a record of the popular will, is merely a safety valve for the escape of accumulated excitement. As a historical fact then, it can be safely asserted that never outside of our own country has the democratic principle been put to the test as the absolute basis of government. If any of the Swiss Cantons have formed an exception, the ray was so dimmed by the surrounding darkness as to have been scarcely perceptible as shown upon the pages of history. Moreover, it can be safely asserted that never before has so large a proportion of the entire population been admitted into an active participation in the making of the laws, and we may rest assured that no step will be taken backward. No human power can arrest this flood of public sentiment in this country on the matter of suffrage, and it will widen and deepen as it flows. On its surface the commune may lift its hydra-head, its waters may be crimsoned with the blood of revolution, but it will sweep onward, bearing us, either as Carlyle has predicted, over the fatal Niagara, or else out into a tranquil sea of fraternity and happiness. It is idle to discuss the question of limiting the suffrage. Under the police power of the State, disfranchisement, either temporary or permanent, may be imposed as a penalty for wrong doing, or enfranchisement may be withheld from those who are the wards of the State, but if the government derives its just powers from the consent of the governed, then this is the extent of the limitation that can rightfully be imposed. As before stated, a democracy is based upon confidence that men want to do what is right, that they have an inclination and the ability to live in harmonious relation with one another, and each for himself in his own way, to work out his own destiny. What a grand conception this was. What an exalted opinion of the possibilities of the race! Such teachings are inspiration, recognizing and making known the skill of the Creative hand in the social as well as in the physical world, prescribing an orbit for each individual, and in which he may revolve with the same regularity and safety that the myriads of worlds move one about another. It is the application of divine law to human affairs, placing men in the relative position assigned each by God, teaching them that all antagonism is abnormal, a transgression, a departure somewhere. It will not be contended, however, that antagonisms will not arise. As we struggle on towards the dizzy heights of national greatness and perfection, the lightnings of fanaticism will flash, and the storms of revolution will rage, but above shines the light of eternal truth, and the philanthropist, undismayed, with full faith and unfaltering step, moves steadily onward. He realizes that "behind us, behind each one of us, lie six thousand years of human effort, human conquest; that before us is the boundless time, with its as yet uncreated and unconquered continents and El Dorados, which we, however, have to conquer and to create." For some wise purpose in the economy of nature, nothing of value is easily obtained. The beautiful world around us has been reached after the fearful convulsions of ages. Hence, social and political perturbations are no cause of alarm and despair to the critical observer of social

and political growth. In every effort made at democratic government the inciting cause of disorder has always been the same. Under such a system every individual of the State, by virtue of his membership, is placed in the vestibule of honor and power and usefulness, and whenever he is worthy he may enter. Every position in society and in the government is attainable as well by the humblest child of the commonwealth as by the child of fortune. This tempting prize is kept constantly displayed. Our Hercules is the people, and the crown of olive is the popular favor. This is a powerful stimulus to ambition, and as a result every energy of mind and body is kept constantly employed, producing restlessness and often disorder. The goal may be imaginary, the light alluring us onward a mere *ignis fatuus*, the prize valueless, but still an ambition incident to all healthy development forces us into the contest. Selfishness is still an element of our nature, and the strong will encroach upon the weak. This produces hostility and social disturbance. We have differed and are suffering from these maladies, but it is illogical to attribute them to any national decay; but they rather demonstrate that the vital forces of the system are active. The political dyspeptic may see nothing but danger, the faint-hearted may be ready to turn back, the traitor may desert his standard, but the great body of the American people are animated by the living principles proclaimed upon the morning of our independence, and have an abiding faith in their final triumph.

But although our political edifice is built on absolute truth, and its architecture in every part perfect, the work of completing and embellishing this temple devolves upon the individual members of the State. They must add to it pure lives and faithful service. This suggests at once the obligations of citizenship.

What are the duties devolving upon those who are in the enjoyment of this priceless heritage of free government? The very term citizen is full of significance. What was once the freeman of a city is now the freeman of a nation, and his influence is not even limited to its confines, but it is either "a blot, radiating to the very confines of society or a blessing, spreading benedictions over the length and breadth of the world." We no longer dwell in walled towns, the foreigner is no longer the barbarian, and the true citizen of the Republic is the citizen of the world. He is a freeman, as God made him, with capabilities and hopes and aspirations for still higher enjoyments. By the Divinity within him he realizes that his ultimate allegiance is to the Author of his being.

The citizen of the Republic is not a subject. Whatever may be the authority approving that term, it can be readily seen that it is repugnant to the whole idea of a democratic government. It is feudal in its extraction and implies subordination of the community to some extraneous power. The whole duty of the subject is loyalty. The feudal relations consisted of support, protection, maintenance on the one part and fidelity on the other. The subject was a vassal—the citizen is a sovereign.

If such, then, are the prerogatives of citizenship, what are its resulting obligations? What is the whole duty of the citizen? What is the whole law governing him? Justinian sententiously expressed it, "*Vivere honeste alterum non lædere*

suum cuique tribuere." This comprehends both individualism and the community. This two-fold relation must be kept in view in determining the obligations of the citizen, and while he is a factor in the product called government, he is none the less an independent, responsible unity. If he is, then, remanded to his normal condition of individual responsibility, the first obligation that can rest upon him is that he be self-sustaining—not a burden in any way to the State or to any other person. This requires intelligence, industry, economy. Moreover, if this independence is to be maintained, it implies the acquisition of material wealth, meaning thereby a reduction to possession of the riches provided by Nature. This store-house of food and raiment is placed within reach of the individual, and by his own efforts he is required to provide for himself and for his household. But the price to be paid is exertion—hence, he who subsists in society otherwise than by returning a full equivalent in honest toil for all he enjoys is a drone, and deserves to be expelled and driven into the misery and disgrace of his own isolation. Mr. Greeley was never more philosophical than when he said it was an unfortunate moment in the life of any man when he first conceived the idea of possessing a dollar he had not earned.

Wealth, then, in its true sense, represents industry, thrift, frugality, all the activities of both mind and body, and when lawfully acquired and kept in strict subordination, there is no more powerful agency for good. If the life-work of the citizen brings him in contact with the material world, it becomes his duty to appropriate it, to establish over it a dominion enuring to his own benefit and that of the State. Nothing is more irrational than the discussions we often hear upon this subject. In them it is maintained that the possession of property is incompatible with the highest forms of intellectual and spiritual growth. Any passion, however holy, may gain the mastery, and so industry and frugality may develop into avarice and avarice lead to dishonesty, but there can be no greater mistake than the supposition that property involves dishonesty. The enriching of one is not the impoverishing of another. All true riches come from that mine of wealth in which yielding does not impoverish. Among business men—those of the largest and most varied experience—the principle is well understood, that absolute honesty is the basis of all business activity, that as an economic measure "honesty is the best policy." Then away with all the false teachings that it is ignoble in the citizen to contribute his highest efforts to swell the material resources of the State! By honest labor mind establishes its dominion over matter, and it takes shape in all the beauties and refinements of civilization—the untamed forces of Nature are thus harnessed to the car of human progress, and, under the guidance of wise laws, the individual and the State are carried forward to still higher possibilities and enjoyments.

This contest of the individual with Nature can be and must be made in strict conformity to law. In a state of barbarism, it is by force alone that rights are asserted and maintained, while in civilized society the law affords a remedy for every wrong, and all force, save as a penalty, ought to be thoroughly eliminated. It can then be said that every form of violence, actual or inchoate, including all

the incipient steps, is a violation of one of the very first obligations of citizenship. Each can reach the utmost limit of his capacity without trespassing upon the natural domain of his neighbor, and it is his duty to do so. The world was made upon a scale sufficiently large to afford ample room for individual expansion without any wrong to another.

But to be self-sustaining, and to obey the laws, is not the whole duty of the citizen. Over all is placed the protecting shield of government, an agency of the State, and at the common expense it must be maintained. The individual is one of a community of people who constitute the State, and by them for the common good, the government is established. This expense is incurred for the benefit of all, and justice requires that each should pay in proportion to his means. This obligation is as binding as any between man and man, and wilfull evasion of it is as dishonorable as any other form of fraud. Plainly stated then, every individual is obligated to pay his proportion of the public revenue, and he who evades it by false returns, depreciated valuation, or any other popular artifice, is dishonest, and there ought to be a public sentiment that would brand him as a criminal, for he is one, actuated by the same motives and with like results. By operation of law this demand arises in favor of the State, what one evades another must pay, and to that extent he has appropriated to his own use the property of another. And he who does it deliberately and thoughtfully, under like favorable circumstances would commit any like crime. If perfection had been, or could be reached, then every one would be a perfect law unto himself. This, as before said, would be the consummation of all progress, but until it is reached government is a necessity. "If all men would practice justice, they could live together in peace without a legal code." But no ray of that millennial morn has yet tinged our horizon. Government in some form must exist, and to support it is a duty to be not only honestly discharged, but cheerfully. The complaining citizen is just so far a bad citizen, a discord, destroying the harmony of society. If evils exist that can be remedied, he ought to direct his energies to that end, or if remediless, then complaining accomplishes nothing only to infuse discontent into the general mind. These public scolds are tolerated in every community, and the only good they ever accomplish is to stimulate the inquiry as to what could have been the purpose of their creation.

In a democracy the government is the voice of its citizens, whether expressed directly or through chosen representatives. To express this voice—that is to vote—and to take an active part in all proper measures for formulating the public will, may likewise be claimed as a sacred obligation. When citizenship was bestowed, to vote was a privilege to be exercised at pleasure, but when citizenship is an inheritance an earnest participation in all political activities becomes the highest duty. "The difference is so wide between a good government and a bad one, the interests at stake are so precious, that indifference in politics becomes a crime." Many of the duties of citizenship are disagreeable. But heroism is not confined to the battle field. The conflict between virtue and vice is constantly going on, and he who would shrink is a coward. The only weapon required is an in-

telligent, vigorous manhood. Let the voice go up from the field and from the work-shop, from the store, the office, the counting-room, from the quiet retreats of scholarly life—all blending in the harmony of beneficent government. Leave not the work to the demagogue, to the professional politician, to the selfish, sordid man, nor to the ignorant rabble. If so left, let there be no murmur when the crimson flag of revolution is unfurled and oppression, violence and disorder reign.

The battle is determined at the ballot-box, but the forces, for good or evil, are organized, armed, drilled and officered in the ward meetings, the primaries, the caucuses and conventions. These constitute the germ-cells in the political organism, from which will be developed law and order or misrule and anarchy. If the fountains of political life are thus fed by streamlets of individual influence, of what prime importance it is that the sources be pure. The highest demand of good citizenship is not intelligence, or influence, or the possession of large interests. It is not social rank, but it is the purity of personal character.

The conditions of men are largely adventitious. Success in business is often accidental. One is carried on the wave of popular favor to positions of honor without any special merit of his own, while another, more meritorious, is borne by some unfelt breeze into the storm line of misfortune and is dashed to pieces. One is born to health, another to sickness; one to genius, another to inferiority; one to fortune, another to poverty. Why this diversity exists is beyond our knowledge. But a oneness is seen only in their common similitude to the great Author of All. In this likeness consists character, this attribute alone is God-like, it is the stamp of Divinity. Reputation is a shadow, character a substance. Progress is made individually, or as a nation only as character is developed. He is a good citizen, and he only, who can stand before the mirror of his own conscience and behold a healthy, symmetrical manhood. Character knows no rank, nor station, nor condition. It dwells as often in the thatched cottage as in the gilded palace. It is manifest in the faithful servant in whatever part of the vineyard he may labor. The elevation of character attained is the only correct standard by which a judgment should be formed. It is an inward growth, a divine leaven, leavening the whole lump. In all that is grand in human nature the humblest menial if faithful to his trust, is as far above the scheming demagogue, the prating charlatan, or the canting hypocrite, however clad, as the heavens are above the earth. The good citizen is not the lawyer or doctor, the professor or the divine, the merchant or the trader, the mechanic or the artisan. Citizenship is not a profession studied or trade learned, nor is it a privilege bestowed, rather it is the attribute if humanity, and he that is a good man is a good citizen, and he that is a bad man is a bad citizen. Hence, in our pride of citizenship let us not look out upon our broad possessions, nor down from our uncertain height upon the social ladder, but rather let the eye be turned inward, let it look into all the chambers of the soul and learn if it is filled with the atmosphere of truth, lighted with intelligence and warmed with love. The obligation due to society by every individual is not that he be wise, or great or rich, but it is that he improve the

talent which God has given him. This interesting subject invites us one step farther, and we have done.

The forces of society are not all direct from the individual to the Government. The whole obligation of the citizen is not discharged merely in building up his own manhood, in sustaining himself, in helping to bear the public burdens, in the intelligent and virtuous exercise of the right of suffrage. There is a correlation of forces in society as in nature. Paradoxical as it may seem, all human progress is on the one hand toward greater individualism, and on the other toward greater mutual dependence. It is an error to suppose that these laws of development lead in opposite directions. They run parallel, and as the individual progresses every desire inconsistent with the most perfect social organization is abandoned, thus removing all cause of divergence, and in the end the highest interest of the individual, and the highest interest of the community coincide. This is the law of social organization. Every man is his brother's keeper. The welfare of each is involved in the welfare of all. It is to the interests of each to establish reciprocal relations in sympathy and in action with his fellow men. Whatever affects the community affects every member of it. Kindness, sympathy, generosity, regard for the rights of others will generate a social atmosphere so fraught with life as to force the purified blood into all the ramifications of the body politic, while selfishness, intolerance, prejudice, bigotry infuse their poisonous vapors into every department of society producing blight and decay.

In a Democratic government, the law of equal freedom is the law of the State, and every infringement of this will produce its legitimate results, and every trespass committed is a wrong done for which all must suffer. Hence it becomes a matter of importance to the citizen not only that he do right himself, but it concerns him that every other one should likewise do right. This dependence makes the conduct and business of every individual of interest to every other one. He sees "that whatever produces a diseased state in one part of the community must inevitably inflict injury upon all other parts—that his own life can become what it should be only as fast as society becomes what it should be—he becomes impressed with the salutary truth that no one can be perfectly free until all are free; that no one can be perfectly moral until all are moral; that no one can be perfectly happy until all are happy." It is the law of the universe that like produces like—society and government form no exception. If the wind be sown the whirlwind will be reaped. Virtue produces virtue; selfishness produces selfishness; love begets love; hate begets hate. He who loves nobody will be loved by nobody. He who gives nothing will receive nothing. In many cases it is difficult to trace the channels through which our conduct toward others returns upon us, but the reaction will surely come. He who would do the most for himself must do the most for others. No man can infold himself in his own individuality. "What we do is transacted on a stage of which all the universe are spectators. What we say is transmitted in echoes that will never cease. What we are is influencing and acting upon the rest of mankind." Let the citizen realize that in living for himself he is living for

others, that his obligations embrace everything that will make others happier and better, that whatever he has of influence belongs alike to himself and to the community,—whatever sphere he may occupy whether mixing with the roaring cataracts of social convulsions or mingling in the eddies of domestic life, let him realize that it is his duty to contribute of his time and enegies to the public good, to strengthen the weak, lift up the down-trodden and encourage the faltering so that the whole army of civilization may move in one unbroken column. This may be an ideal and impossible state of being, yet even the goal toward which our actual state of being strives, which is the more perfect the nearer it can approach. The true citizen of the Republic is the the perfect man, loving the Lord God with all his heart, and with all his soul, and with all his strength and his neighbor as himself.

NATURAL HISTORY.

PECULIARITIES OF OUR ORNITHOLOGY.

BY ERMINE CASE, JR., KANSAS CITY.

Science is but observation tabulated. The observer need not necessarily be a scientist. If he be a faithful reporter his contributions may be as valuable to science as the technical collator's tables. The lovers of nature and the sportsmen have been in all times invaluable assistants to the specialists. As the literature of science becomes less technical and more popular in its character, thousands of observers are added to the army which is marching upon the rocks, charging upon the herbage and flanking the animal kingdom—compelling their secrets for the use of the laboratory and the museum. The alchemist has disappeared. The crucible he used to turn dross into gold is now presided over by the quiet, earnest man, looking only for truth. The unscientific observer should not preface his report with an essay, so we proceed.

The district included within a radius of one hundred miles from Kansas City is similar, in the respects we shall mention, to the remainder of the central Missouri valley. There exist in this region peculiarities in the habits of birds well worthy of record. There also exist here many species of birds whose habitat has been placed in distant latitudes containing conditions of climate, atmosphere, etc., very different from ours, and it is very strange that so little has been said of the many marked peculiarities in this field. But it is not the object of this paper to note all the differences which have been observed, but only to suggest the subject by some well defined instances.

The common quail or Virginia partridge exists in large numbers in all quarters of the United States east of the 100th meridian, possibly west of it, it matters not in the premises. Taking the state of Ohio as a representative region for the Eastern and Middle States it will be acknowledged that quail on that parallel do not immigrate to the southward in the autumn and return north again in

the Spring. There a covey of these birds can be found every day for an entire season within one hundred rods of the same spot, and even pursuit with dog and gun will not drive them away. But it is quite different in the region we have named. Here the quail do pass to the southward every fall, beginning usually about October first and continuing until mid-November unless the season is severe. The movement is general and is continued persistently. Each covey maintains its organization and its direct, independent march toward the south, not diverging from a right line even to avoid towns or considerable cities. Wide rivers do not deter them—they often fall into the Missouri, not being able to sustain their flight across.. When frightened they scatter but still fly on to the south, quickly calling together again to pursue their certain road. How far they travel cannot be definitely known, as they cannot, of course, be followed, or identified, but that they become poor and lean by their long travels is well known. We can feel certain that they do not generally pass below the northern line of the Indian Territory, as they are found gathered in the southern counties of Kansas in unusual nnmbers during mid-Winter. They pass north with the same fearless directness in March and April, but not always in flocks, having then, in the great part, paired.

The pinnated grouse or prairie chicken migrates to the south in the early autumn and returns northward in the spring, This is not strictly peculiar to this region, but it is more general and the flight is to a lower latitude than in the region east of the Mississippi River.

Piercing cold, driven by furious winds over an unsheltered country, is suggested as the chief cause of these migrations. The same causes affect the smaller birds of all kinds. More of them go south for the winter and they go farther than is the habit of the same species in the Ohio region.

We pass to a peculiarity of another character. Along the Atlantic coast of the United States are many birds of a semi-aquatic character. They frequent the salt marshes, bars, inlets, creeks and tidal margins. They pass backward and forward every season. They are known among sportsmen and writers as "Bay Birds" and this term includes a half dozen varieties of plover, turn-stones, sandpipers, godwits, curlew, etc. Very few of these birds are ever seen between the head of tide-waters of the Atlantic and the western part of the State of Missouri; but as the timber country thins out into broad prairies and the prairies in turn rise into the higher plains, we begin to find in the high, dry altitudes these same birds which we had left in the moist region of the sea levels. What should take this host of waders to the sand-hills and alkali plains of Western Kansas and Nebraska? Here are the great sickle billed-curlew, the golden plover, the smaller and greater willow legs, the common gray plover and the large brown godwit, with almost every species of the other bay birds with which one could become familiar at Montauk Point or Barnegat Bay. The conditions of climate vary widely, as must also be the case with their food, opportunities for resting, and the practice of their peculiar habits of wading and mud-dabbling.

We can only query whether they may be waiting for the return of that ocean which in early geological times we are told covered the great plains.

We pass to another branch of our topic. Mr. Stanley in coming down the Congo met with flocks of pelicans, cormorants, gray plumed herons and white cranes. These strange birds, of uncouth form and weird plumage, seem well fitted to the equatorial wilderness in the valley of that great river. Those birds are indigenous to the retired swamps of Florida and the gulf coast, but they are unknown in the middle region of the United States. On the wildest parts of the Ohio, Tennessee and Cumberland rivers they are so rare, if ever seen, that mention is never made of them. But here on the Missouri, on the Platte and the Kansas rivers, and on all the small lakes of the valleys, all of these species are regularly seen. If one will float quietly down the Missouri in a small boat from St. Joseph to Kansas City in the month of November, he will find, on the bars, not only the great white crane, collossal in height and in the extreme spread of its wings, but the cormorant with its red face, dark plumage and dull, heavy motion; the pelican in groups fishing in the shoal waters and also in the bayous, the plumed heron with long crest and beautiful grey-blue plumage, erect, still and vigilant. He will meet at the same time a half dozen varieties of gulls, ranging from the light grey ocean swallow, smaller than a pigeon, to the enormous white gull of mid-ocean. It is a rare and interesting sight for the keen, business loving people of our latitude, upon this stretch of our great, unpicturesque river, to find these denizens of foreign lands sporting and feeding among the wild fowl, of which the usual varieties are so plentiful upon our waters.

Here we wish to place on record a narrative of a most singular occurrence witnessed by the writer and a friend while hunting ducks at Bean's Lake in Platte County, Missouri. It will be found a most vivid illustration of the topic under consideration, while at the same time describing the wonderful intelligence of a bird whose habits of solitary life have kept it beyond the ordinary observation of men.

While sitting behind a "blind," over our decoys, waiting for game, on the 3d day of April, 1875, we saw at the distance of a mile toward the west end of the lake a large number of huge white birds, and, watching them curiously, finally discovered that they were coming toward us on the water—a host. In an hour the mass was abreast of us, and proved to be made up of pelicans, a band we estimated to be sixty feet in width and three hundred feet long closely packed together, each one touching his neighbors on all sides. It appeared as though a foot ball could not have fallen to the water at any point on the band. They moved as a raft might move with a slow current—no motive power visible, each one maintaining his place without flutter or struggle. Moreover, they were unlike swan or geese in that their heads were not raised, being drawn backward and laid upon the back between the wings, while the long mandibles lay forward, flat upon the neck. Not a sound or a motion from an individual, only the still, solemn glide of the entire raft. And yet there were many thousands of them. Allowing a foot in width and a foot and half in length for each bird, there were twelve thousand

pelicans before us. They passed on to the lower end of the lake, then almost immediately rose and flew back over us and settled again in the shoal water. While flying, the pelican shows the broad black band on the extreme feathers of the wings, and would be a very beautiful bird, but it does not stretch forth the neck, even while flying, thus appearing like a swan with his head cut off—*very awkward.* During the day this vast multitude was joined by scores of large flocks, which came down from the sky, circling down in narrow spirals from a height from which they could not be seen. Whence did they come? What was the object of the meeting? Who was the messenger that had called this horde together? They must have gathered from all the corners of the earth, for by extensive inquiry made since that day among those most likely to know, no witness has been found who ever saw more than fifty together in one place in this region. All day long they moved slowly about the upper end of the lake and only occasionally did small groups fly about or splash in the water. A great and solemn convention was evidently being held. Toward evening, however, we saw more commotion among them and, desiring to witness more closely this wonderful gathering, we went up the lake toward them. After quietly approaching within a half mile of the nearest, we saw that a general motion was being made in our direction, whereupon we concealed ourselves close to the edge of the water and from thence during the next hour witnessed the most amazing pageant of our lives.

The number had clearly doubled since morning, and the entire troop were arranged in line and engaged in a movement the object of which we could not at first make out. The line was some three hundred yards in extent, and at least thirty birds in depth—all "dressed" to the left (continuing the military figure), and at that wing resting upon the bank from which the line slightly diverged, at the extreme right being some thirty yards out; the general movement being toward the shore. As the birds on the left reached the land, they immediately rose in the air and passed back of the line and formed again on the extreme right. In this way probably five hundred birds were flying at a time, and by this method of deploying from the left to the right wing, the grand army was being rapidly moved toward us. When quite near and before us we easily saw that the object of this advance in order of battle was not mere dress parade—each bird was rapidly dashing his head under water, bringing up fish. This long line then was a seine fastened to the bank at the left and being gradually drawn toward the shore, driving the finny prey into the shallow water where it was incontinently swallowed by the living meshes of this enormous net. Nothing could be of more thrilling interest than to witness the intelligence with which this enormous flock carried out every detail to success. Several times we noticed a detachment, as if detailed for special duty, swing around over some deeper pool, flying so as to drag their feet and flap the extremities of their wings upon the water, closing in finally at the open end of the net on the right. Had a skiff load of boys been sent out with poles to splash the water and drive in the fish, the maneuvre could not have been plainer in its object than was the one before us. Why should one flying group "drive" in this way, while other scores passed regularly on to their places?

Where was the commander-in-chief? There was no struggle for precedence, no fighting, no pressing out of line; here was a voiceless, disciplined multitude, intelligently carrying out an elaborate plan.

When the line had advanced and lay within thirty feet of us, we rose quickly and fired our guns over them; and when this myriad rose, utterly filling the air, the broad wings crashed against one another with the roar of a hundred trains. Thus closed this most wonderful spectacle.

A specimen we obtained measured nine feet and a half from tip to tip of the wings. The mandibles were fifteen inches long, and the pouch held two quarts of wheat.

On this same day we observed on the bank of the lake a small flock of of Cedar birds. These are rare visitors, so rare that our best observers seldom see their bright, brown plumage, crested heads

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CORRESPONDENCE.

SCIENCE LETTER.

PARIS, November 26.

The most popular of the scientific sections of the Exhibition, is undoubtedly that devoted to Anthropology. It is happily symbolized by a statue near the door, holding a skull in one hand, and a compass in the other. M. Quatrefages defines Anthropology as the "Science of Men," as zoölogy is the science of animals, and botany the science of plants. But it has subdivisions. Anthropology is "zoölogic," when we wish to describe not only man's place in nature, but the characteristics which establish his quality of man. It is "ethnographic," when we compare the races of man—a most difficult branch. It is "pre-historic," when we study antique man; "linguistic," when we research the ties of language and the migrations of people—the surest of all tests; and it is "demographic," when it investigates the condition under which people develop and extend; how they degenerate and die out. The last classification can be applied to Europe with a mathematical precision. The "zoölogic" standpoint is the most thorny; it has to encounter all the nonsense propagated about the descent of man from monkeys, and is placed in opposition to theology. Science has nothing to do with either theology or politics; it seeks out facts, and reasons coldly over them; free to those who please to build up or demolish theories accordingly. It is, however, clear that the sole means to classify a being in natural history, is to ascertain the distinctive characters which separate it from other beings. Why should man be exempted from this simple and general rule? Hence, why the skeletons of monkeys are necessary for comparison, those of the ourang-outang especially, because it alone of all the monkey tribes is a biped. A vertical position modifies the whole animal system. The form of the vertical column, the

position of the muscles, of the viscera, and notably of the heart, are widely different in a quadruped and a biped. But the skull of the great monkey, owing to the enormous muscles of mastication, is the very opposite in shape to man's—it tapers at the summit so as to form a crest. Skulls are divided into two classes, the round and the elongated, with many intermediary forms. The negro never comes under the first, still less the Laplander under the second class. The brain is too soft to be dissected, and very difficult to be preserved; so it is weighed, and the capacity of its shell, or skull, measured. Anthropology has nothing in common with phrenology. It is curious, and morally and legislatively an important fact, that in the collection of murderers' skulls, from the Caen museum, traces of an old malady of the brain or its envelopes are uniformly discernible.

The form and color of the hair have their importance; the eudimous crisped hair of the Papuans contrasts singularly with the straight character of that of the Chinese—largely employed in Paris. In the latter case the hair is cylindrical, in the former it has a ribbon nature. Savages dye their hair as extensively as civilized people. There are specimens of domestic life, and dressed models of various peoples, exhibited. It is curious that while the peasants of Finland—every one of whom knows how to read and write—and of Sweden, are essentially different as to type, they are identical in point of dress, cottages and furniture, while the Laplander resembles neither. Finland borrowed her civilization from Sweden, and Swedish is the language spoken in her cultivated circles. But here are French girls from Savoy and Auvergne, who represent on their robes the amount of their *dot* or fortune; for every thousand of francs they possess, they place a row of braid at the bottom of their jupe. Now, certain Indian tribes do exactly the same. The Indian collection of the Prince of Wales, so valuable materially and artistically, is also so, anthropologically; the specimens of the swords are remarkable for the smallness of the handles, for the natives have hands at once little and elegant. The same diminutiveness characterizes the arms of the age of bronze, thus confirming the opinion that the people who brought that metal into Europe were of Indian origin. The brooches and clasps actually in use in India, have been found in Ireland, in the sepulchres of the age of bronze. Japan displays photos of the Hinos, a population with European traits, who formerly inhabited Japan, and now are cooped up in a corner, in process of dying out. Among the specimens of arms from Australia and Polynesia, the latter have no bows, and so differ from all other nations, while the Papuans possess these weapons. But the Papuan bow is very imperfect, and in no respect resembles that of the Greeks or the archers of the middle ages, when the bending of the bow was a difficult operation. It was in being alone able to bend his, that Ulysses made himself known to the Ithacans. The bow of the English archers, such as it is represented on old tapestry, was that of the ancient Mexicans, and such is still the weapon of negro bands. The women of the Kabyle tribes make the famous Algerian pottery; it is ornamented with Arabian designs, but the fabrication displays the impress of the women's fingers, thus connecting the pottery with that of the epoch of the dolmens. The castanets that

the Moors imported into Spain are of negro origin; but the negroes use iron castanets, and it is known that it is to them that we owe the transmission of industries in iron. The ancient inhabitants of Arizona and New Mexico, scooped their dwellings in almost inaccessible cliffs, with a kind of goat-path leading thereto, and for greater security the entrance even to the house was effected by meansof a ladderr Their descendants, judging from the model of a village shown, no longer live in cavern houses, but in villages enclosed by walls, where the houses are so close together as to appear to be piled one above the other, and all have the ladder mode of entrance still.

Two theories of the origin of carbonic acid have been propounded, and which, if not conclusive, are ingenious. The air is composed of two gases, oxygen and nitrogen, in proportion of nearly one and five respectively; to these must be added small quantities of watery vapor and carbonic acid. Vegetation absorbs this acid from the air, for its chief food, while at the same time purifying the atmosphere. When charcoal is prepared, we merely extract from vegetation the carbon it had appropriated from the air. Though only present in small quantities in the air, the importance of carbonic acid is such, that without it vegetable, and consequently, animal life, could not exist. But it also plays a prominent part in the constitution of the strata of the earth, combined with lime and magnesia, for example. It is thus we have marble, chalk, etc. In the granitic rocks, that form, as it were, the skeleton of the globe, lime and magnesia are found, but not carbonic acid. How, then, were the calcarean beds, containing fossil remains, supplied with their carbonic acid? Either the air at one time contained an excess of it, or it was derived from an exhaustless source. The first hypothesis is since a long time abandoned. It is calculated that a layer of lime, nine yards thick, and covering the globe, would absorb a weight of carbonic acid equal to our actual atmosphere, to be transformed into a carbonate. Supposing that all the carbonic acid fixed in rocks, existed then at one time in a free state, the total quantity would have been such, that under its own weight it would be relinquished, and life thus rendered impossible. Now it is precisely since the appearance of life on the earth, that the carbonate rocks have been formed. Enormous quantities of carbonic acid must have arrived to replace those absorbed. Consumption on one side, supposes restitution on the other. From whence comes this restitution. One theory maintains, that oxygen, nitrogen, and carbonic acid, exist in space, become condensed in the neighborhood of planets, following the density and temperature of the latter, forming atmospheres, and thus supplying surfaces with all the carbonic acid they need. However, the moon has no atmosphere, and Venus and Mercury are provided with thick, gaseous envelopes, not at all in proportion to their volume. Asteroids, like the moon, have no atmosphere, and consequently no relation with condensed universal cosmic matter. The other theory, confirmed by many eminent geologists, is that carbonic acid emanates since all time from the interior of the earth, welling up to the surface. The masses of iron found at Ovifax, on the coast of Greenland, re-

semble in composition, meteoric iron, as well as that of iron from the basaltic rocks, both containing carbon; carburet of iron has been found in the oldest granitic rocks. But how does the oxidation, to form the carbonic acid, take place, since oxygen is very rare in the interior of the globe? M. Cloiz has shown that by acting on cast iron with hydrochloric acid and water, or simply with steam on a mixture of iron, magnesia and carbon, he has obtained oils, bitumen and petroleum, and which explains the origin of this mineral oil; carburetted hydrogen is thus formed, and as it ascends toward the surface of the soil, it encounters oxygen, carbonic acid and water being the result. All this involves the supposition that the center of the globe consists of a kind of kernel of carburet of iron, which can be dissolved by the action of water. Volcanoes vomit volumes of carbonic acid, mineral waters are rich in it, and certain fissures in the soil exhaleit. The presumption then is that the source of carbonic acid is from below, not from above.

France, in railway rolling stock, displays at the exhibition, not so much anything original, as a readiness to adopt what is practically beneficial. Her companies establish a difference between passengers and merchandise; we are transported more rapidly, and in a certain degree, more comfortably and safely. Fearing that the English traffic would be attracted by Belgium and Germany, more powerful engines have been employed, and hence greater rapidity secured. But "wild cat" and "lightning trains" are still unknown. Again, only first-class carriages make up an express; the "sleeping car" is still a luxury, and not far removed from a novelty; no trains are lighted up with gas, as in Belgium. But the roads are good; steel rails, and of greater length—12 instead of 6 yards—are employed, and only oak sleepers used. Tenders being larger, contain more water, and thus necessitate less stoppages. The steep lines and short curves in the districts of the Cercunes work admirably, and in the tunnels, full of vitiated air, the engine driver and stoker are provided with respirators, and inhale, for the time being, pure air stored in a cylinder. On the line from Bayonne to Bianitz, M. Mallet has employed the compound system of locomotive and Cardiff coal, with advantage and economy. All classes of carriages are now heated with hot water foot pans; the second-class compartments are wider; the wheels are lubricated with oil, not grease, and the smoky oil lamp has nearly been replaced with rectified petroleum. Rapid traveling and increased traffic augment the chances of collision, hence the question of brakes. Formerly a train could not be stopped in less than 900 or 1,500 yards; a second on a railway, as in navigation, has a life or death importance; in a second an express runs 22 yards; in 22 yards, in a second less, a catastrophe could be avoided. The brakes in favor are, the Westinghouse and the Smith; the former works by compressed air, and by the driver simply turning a cock, he can pull up a fast train in a distance of 200 yards—the length of an ordinary platform. Hence, when the traveler imagines his train is running through a station, it suddenly comes to a stand still, with more or less of a shock, as the driver, if in good humor, neatly applies the

blocks. The brake is also automatic, each carriage being provided with a reservoir of air, so that if a separation in the connecting pipe ensues, the blocks, owing to the rupture, will instantly and independently grip the wheels. In ordinary working the brake stops the first carriage next the engine, then the second; hence, telescopic shocks are experienced. The connecting air-pipe makes the formation of the train an inconvenience, and the valves, very delicate, require a special repairing. The Smith brake acts by rarefied air; a kind of India rubber bellows is under each carriage, with a bar commanding the blocks; a feed pipe communicates with the engine; a jet of steam in the pipe chases the air, and creates the necessary vacuum; the last carriage is stopped first; hence, there are no telescoping shocks as in the rival plan, and the trains further are easier to make up. It suffers from the drawback of not being automatic. It would be well if companies adopted a uniform brake as in Belgium. M. Achard's electric brake is destined for the future. The Lartigne signal is working well; as soon as a disc falls it liberates a current of electricity which lodges in a block of metal at a long distance from the signal; the approaching locomotive is provided with a metallic brush, which, sweeping the block, communicates the electric current by a wire to the whistle, and the latter automatically "blows"; the current even can be arranged to act on the cock of the brake tube, and thus pull up the train, even were the driver to be in a trance. The "definite brake" has yet to be found, but the "Smith" is generally viewed as the most practical up to the present.

Aided by the Council General of Tours, M. Mouchat has been able to repeat on the Trocadero, his experiments of boiling, wasting, and distilling, by means of the sun's rays, collected by a reflector 22 yards square, and concentrated on a boiler containing 70 quarts of water, which on the 2d of September, were converted into steam, in half an hour. The steam next pumped 2,000 gallons of water two feet high in an hour, and then worked the Carrė machine, and turned out blocks of ice; smaller reflectors cooked a pound of beefsteak in twenty minutes, made a pot of soup, and distilled and rectified brandy. In Africa and kindred countries, where the sun is rarely obscured and fuel may be wanting, the invention might be utilized, but its drawback consists in not being stationary; a delicate clockwork movement is necessary to make the reflector constantly face the sun, follow the orb, in a word. F. C.

A NEW ELECTRIC LAMP.—M. G. Reynier describes in the Camptes Rendus, 1878, lxxxvi, p. 1193–94, a light which obviates the use of regulators. It consists simply of a thin rod of carbon which is connected with one pole of the electric generator and is pressed against a wheel which is connected with the other pole. The carbon glows at the point of contact, and, as it bures away, moves the wheel to another point of contact. The inventor claims to have produced a light by means of four Bunsen elements and to have produced several lights in the same circuit.—*Am. Journal of Science.*

ASTRONOMY.

RECENT THEORIES OF THE TIDES.*

J. M. ARNOLD, BOSTON.

"The tides," says Dr. Herschel, "are a subject on which many persons find a strange difficulty of conception. That the moon by her attraction, should heap up the waters of the ocean under her, seems to many persons very natural. That the same cause should at the same time, heap them up on the opposite side of the earth, seems to many palpably absurd."

The explanation of the cause of the tides, usually given in text books and popular treatises on the subject is, that as the attractive force of the moon decreases as the square of the distance increases, the waters of the ocean under the moon are attracted more strongly than the center of the earth is attracted, and consequently are slightly drawn away from the earth, by a force equal to the difference between the attraction of the moon at these points. On the other hand, the center of the earth being more attracted toward the moon than the waters on the opposite side of the earth, the solid nucleus of the earth is drawn away from the *waters* on the opposite side, by a force equal to the difference of the moon's attraction on these points, thus leaving the waters on that portion behind. There would therefore be two tidal waves existing on opposite portions of the globe, which, by its daily revolution, would cause at any particular point on its surface, two high and two low tides in each lunar day. This theory of the tides is given by Lockyer in his "Text Book on Astronomy," in Appleton's Cyclopædia, and in Johnson's New Cyclopædia, in the appendix of which is an exhaustive article by Gen. Barnard, giving the mathematical formula for finding the tide-generating force on this assumption.

About thirty years ago a number of text-books on astronomy were published, which, while they gave for the principal cause of the tides the one heretofore given, claimed a secondary cause for the tidal wave on the side of the earth opposite the moon, to be an increased centrifugal force at this point, generated by a revolution of the earth around the common center of gravity of the earth and moon, but this influence they agreed was a very slight one.

Thus the matter stood until the *Popular Science Monthly* for July, 1877, published an article on the tides, in which the writer maintained that the explanations hitherto given in our text-books, were entirely wrong, and that the real cause of the tidal wave opposite the moon was centrifugal force alone. This writer received much adverse criticism which was published in subsequent numbers of the *Monthly* in the form of correspondence, until the editor refused to give any more space to the controversy.

[Read before the B. A. S. S., October 10, 1878.*]

In a course of popular lectures on astronomy, delivered in this city last winter, the lecturer, after giving the usual gravitation theory of the tides, told his hearers that he thought a better explanation of the cause of the tide on the opposite side of the earth, would be that it was the effect of increased centrifugal force on that side, owing to the rotation of the earth around the common center of gravity of the earth and moon. To illustrate this idea he called on his audience to imagine a huge spike driven through the earth, so as to pass about three thousand miles to one side of its center, and the earth revolving like an eccentric on this spike once in each lunar month.

As this theory of increased centrifugal force on the portion of the earth opposite the moon causing a high tide at that place, has been adopted by one of our ablest astronomers, Prof. Newcomb, of Washington, in his recent work on "Popular Astronomy," I propose in this paper to inquire,—1. What is the direction and amount of the centrifugal force generated by the motion of the earth around the common center of gravity of that body and the moon? 2. What effect has this force upon the tides?

In the discussion of these questions I shall take a view of the matter that will be somewhat opposed to that of Prof. Newcomb, and will, therefore, give an extract from his work, covering what he has to say on this subject.

He says, "Now, strictly speaking, the earth does not revolve around the moon any more than the moon around the earth; but, by the principle of action and reaction, both move around their common center of gravity. The earth being eighty times as heavy as the moon, this center is situated within the former, about three-fourths the way from its center to its surface, at the point G in the figure.

The manner in which the moon produces the tides is much the same as that in which precession is produced. Near the center of the earth, E, the centrifugal force of the earth's monthly rotation around G, and the attraction of the moon, counterbalance each other, so that a point there has no disposition to move under the influence of the combined forces. As we pass from E to D, the part of the earth's surface opposite the moon, the centrifugal force around G keeps increasing, owing to our greater distance from the center, while the attraction of the moon diminishes. Hence, at D the centrifugal force predominates, and tends to throw the waters of the ocean out, as shown in the figure. Again, as we pass from the center E to C, the centrifugal force constantly diminishes till we reach the center of revolution, G, when it vanishes, and, beyond G, begins to act in

the opposite direction. Hence, at C the attraction of the moon and the small centrifugal force around G both combine to throw the waters of the ocean out in the direction of the moon. Thus, there is a force causing the waters to rise at D and C, and therefore to fall at A and B; and there are, therefore, two tides to each apparent diurnal revolution of the moon."

It seems to me that Prof. Newcomb gives us here an entirely erroneous conception of the nature of the motion of the earth around the point G.

That this motion is such that the center of the earth will describe a small orbit, of about three thousand miles radius, around the point G, is true, but this motion is one of translation simply, and not a motion of rotation, as one would infer from Prof. Newcomb's explanation.

The earth has a daily rotation about an axis inclined considerably to the plane of this orbit, but this rotation is entirely independent of its motion around the common center of gravity of the earth and moon. If the axis of this rotation was always inclined toward the moon so as to follow it in its monthly course, then we might say that the earth had another motion of rotation about an axis perpendicular to the plane of the moon's orbit, making one rotation in each lunar month. But as the direction of the axis of daily rotation remains fixed in space, and does not follow the course of the moon in its orbit, we can in no sense, call the motion of the earth in the small orbit around G, a motion of rotation.

As an illustration of the nature of this motion, suppose a person to bend the trunk of a small tree to one side and then move it around in a small circle. The roots of the tree being fixed in the ground, rotation cannot take place, but the center of the top of the tree, moving in a small orbit, will be somewhat analagous to the monthly motion of the earth around the point situated in its interior, about one thousand miles from its surface, and called the common center of gravity of the earth and moon.

Having seen what the nature of this motion is, we next inquire what will be the centrifugal force generated by this motion. At the center of the earth the centrifugal force will balance the attraction of the moon at that point. The centrifugal force developed by any particle, situated at any point on the surface or in the interior of the earth, will be the same in amount and direction as that of a particle at the center. For when we consider that this is a motion of translation without rotation, it is plain that every particle moves with the same velocity on a curve of the same radius. Therefore instead of the centrifugal force being greater at the side of the earth farthest from the moon, and decreasing as we go to the point G, where it becomes zero, according to Prof. Newcomb, I claim that the centrifugal force is the same at all these points, the point G included; for at the same time that the center of the earth is describing an orbit about G, that portion of the earth which at the moment coincides with G is also describing an orbit of the same radius about a center situated three thousand miles in a direction toward the moon on a line joining the centers of the two bodies. At the point C, directly under the moon, it will act in a direction away from the moon, toward the center of the earth, and not in the direction stated by Prof. Newcomb.

We will now consider the effect of these disturbing forces on the waters of the ocean. Each particle will be acted on by two opposing forces beside that of the earth's gravitation, which we call its weight, the moon's attraction and the centrifugal force. This last force being constant in amount, and the attraction of the moon varying with the distance, the particle will tend to move in the direction of the greater force. If placed at the center of the earth, these forces being equal at this point, no tendency to move either toward or from the moon will take place. But if placed on the earth's surface nearest the moon, a slight tendency to move away from the earth and toward the moon must take place, owing to the excess of the moon's attraction over the centrifugal force. On the other hand, if placed at the point farthest from the moon, a slight tendency to move away from the earth, and also away from the moon, will take place, owing to the excess of the centrifugal force over the moon's diminished attraction. The amount of this disturbing force is small, being only about one-thirtieth of the intensity of the moon's attraction upon the particle. But according to Prof. Newcomb's theory, a particle placed at the point nearest the moon feels a lifting force, equal to the whole of the moon's attraction upon it, and the centrifugal in addition, which would give a tide-generating force about forty times larger than it really is. In fact this theory would show that a belt of water would be raised, completely surrounding the earth in the plane of the moon's orbit, making an ellipsoid of three unequal axes.

Without entering into any discussion as to the nature of centrifugal force, which is by some denied to be a force in the strict meaning of the term, I think it will be conceded that the cause of the tide opposite the moon is due to this force. Prof. Newcomb has done well therefore, in a popular work on astronomy, to give this explanation of the tides, instead of that usually given in the text-books, but, by an apparent misconception of the nature of the earth's motion around the common center of gravity of the earth and moon, I think he gives an erroneous view of the magnitude and direction of the centrifugal force. A like criticism would also apply to his explanation of the cause of the precession of the equinoxes.

The question arises, shall we abandon the common explanation of the tides given in the text-books, as the writer in the *Popular Science Monthly* would have us do? Not necessarily. The old explanation of the text-books, views the subject from a somewhat different standpoint, and by a chain of reasoning, different though valid, precisely the same result is reached.—*Science Observer—October.*

Prof. W. T. Sampson. U. S. Navy, after careful observations of his own, concludes that the light of the sun's corona is not all reflected light, and that all the observations of others, taken together, show that the continuous spectrum of the corona is not the spectrum of the sun. He also concludes that the corona is to a considerable extent self-luminous.

STAR-LIGHT IN WINTER.

The Heavens declare the glory of God and the firmament showeth his handiwork.—[Psalms, xix:1.

Through summer's night, by gentle breezes fanned,
  Each sleeping flower gives fragrance to the air;
And while we wander o'er the silent land
  There comes a sweet relief from carnal care.

But, to observe the glories of the sky,
  Far better is a clear cold winter's night,
When no deceptive mist is spread on high,
  And thin frost air unveils each starry light.

Now, while our orb keeps up her endless roll,
  The mighty constellations seem to march
In varied circles 'round the Northern Pole,
  And constant change goes on in Heaven's arch.

Seen first in order from yon central star
  The seven gems of Ursa Major's train
With mellow luster glimmer through the air,
  And shed their rays along the Arctic plain.

Here calm Capella sweeps above the scene,
  There Aldebaran gives his fiery light;
And from the eastern hills with glow serene
  The silvery Twins are sailing up the height.

Now, slowly swinging down the cloudless North,
  Soft Lyra's star illumes the purple sky;
And o'er the misty South is looking forth
  Orion's band—the fairest group on high!

Blood-colored Mars shines fiercely o'er the west,
  And farther down pale Saturn sheds his ray;
While just above yon mountain's cloud-like crest
  The Queen of Love reflects her monarch's day.

Up from yon shadow-wave a star ascends
  That with a regal beauty meets the sight,
And to the realm its flaming glory lends—
  'Tis radiant Sirius—the King of Night!

Thus from their stations in the ether dome,
  Do shine the leaders of the twinkling host:
And when toward the lesser lights I roam,
  Amid their countless numbers I am lost.

Yet, though the mortal mind can never rise
  To even comprehend the starry way,
Jehovah's might a law of Love supplies
  That all the spheres are willing to obey.

By day and night this omnipresent Love
  Is ever manifest to eye and ear,
For every scene of Earth or Sky above,
  Displays the magic word in letters clear. X.

BIOGRAPHY.

PROFESSOR SIMON NEWCOMB,

OF THE UNITED STATES NAVAL OBSERVATORY.

This gentleman is yet in the prime of manhood, having been born in the province of Nova Scotia on the 12th of March, 1835. He is of New England stock, his parents, on both sides, being of families which had emigrated to the province. His father was a teacher of a village school, and possessed but the moderate capabilities of a teacher of forty years ago. He, of course, conducted his son's early education, but the youth having a decided taste for arithmetic, had mastered the subject, as far as his father was able to carry him, before reaching his twelfth year. He also possessed a marked disposition for reading, and the few books which came in his way were eagerly conned. Among them were a Latin and Greek grammar and readers. He also studied the rudiments of French with a teacher, but a better opportunity of acquiring a knowledge of that language was found among neighbors who were descendants of early French settlers in the province. Later he studied algebra diligently—a text-book having been loaned to him by a clergyman. Ere he was eighteen he had thus fitted himself to teach, and obtaining a school in Maryland, set out in life for himself.

About the year 1856 the late Professor Henry, of the Smithsonian Instithtion, had his attention drawn to young Newcomb through a communication on a scientific topic which the young man had ventured to send to him. This led to other correspondence which awakened such an interest on the part of the eminent scientist that he sought and obtained for Mr. Newcomb a position as computer in the office of the *American Nautical Almanac*. Here was a most welcome field for study and effort on the part of the young mathematician. In it he found the material he most earnestly desired, and all the incentives for diligent study. The office of the *Almanac* being then at Cambridge, Massachusetts, he found it convenient to attend as a student the Lawrence Scientific School, where he heard the lectures of Professor Pierce. He studied also the works of La Place and La Grange, and then entered the field of original investigation. At twenty-six he was appointed Professor of Mathematics in the United States Navy, and assigned to duty in the Naval Observatory at Washington.

Professor Newcomb acquired distinction in his branch of scientific inquiry much earlier than the average of men; indeed, he laid the foundation of his fame while a tutor at Cambridge, having then written a paper on "The Secular Variations and Mutual Relations of the Orbits of the Asteroids," in which he exhibited unusual thoroughness and care in his examination of what had already been written on the subject by eminent astronomers, and high ability in his demonstration that the orbits of those small planets could not have intersected unless they had been deranged by some undiscovered cause. To be sure, little attention had been given to the study of asteroidal movements by astronomers hitherto, but the thoroughness, accuracy, and originality of his treatment drew marked attention. A work of considerable importance, produced during his connection with the Naval Observatory, is an "Investigation of the Orbits of the Two Outer Planets, Uuranus and Neptune," which is accompanied with elaborate tables. Toward the preparation of these tables Professor Henry contributed valuable assistance by supplying him with necessary funds from the Smithsonian treasury.

In 1867 Professor Newcomb published his studies with reference to the distance of the sun, a work deemed of high importance by both foreign and American astronomers, who have generally adopted the value of the solar parallax, 8".848, which is one of his conclusions as set forth in the work. In 1870 he visited Europe for the purpose of observing the total eclipse of that year, the path of which lay in the Mediterranean. He was appointed by our government one of the commission to prepare plans and apparatus for the observation of the late transit of Venus, and as secretary of that commission performed the considerable share of duty which fell to him with his customary thoroughness. In late years Professor Newcomb's labors have been in the main directed toward the moon and the possible variability of the sidereal day. He has published several papers on this subject. Hansen's tables of the moon, hitherto received as authority, have been found to deviate from observation for several years, and in a very remarkable manner, and that eminent astronomer has assigned as the cause for such deviation an acceleration in the rotation of the earth. The outcome of

Professor Newcomb's study is the practical demonstration of such accelerated rotation.

Professor Newcomb's name is not associated with any remarkable discoveries, but owes its reputation chiefly to his accurate and thorough work in mathematical astronomy. A writer in the *Popular Science Monthly*, while alluding to this, says: "Perhaps the secret lies in the unity of purpose which has characterized all his efforts. His special field has been that of exact astronomy, the predictions of the motions of the heavenly bodies from their mutual gravitation, and the perfection of the tables in their data, from which the *Nautical Almanac* is prepared, in order that the navigator and surveyor may be enabled to find their way by sea or land. When the late Admiral Davis founded the *American Nvutical Almanac*, some twenty-five years ago, the tables and other materials for its construction were extremely imperfect, but Professor Newcomb's studies have all tended to their improvement.

Professor Newcomb's latest publication is a treatise on astronomy for popular reading. This has already obtained a wide circulation on both sides of the Atlantic, and is generally deemed one of the most clearly-written and interesting works of its class in print.

He has been the recipient of many academical and society honors. In February, 1874, the gold medal of the Royal Astronomical Society of Great Britain was awarded him for merit and valuable contributions to the progress of astronomical science. The same year the Columbian University, at Washington, gave him the degree of LL D., which was confirmed in the following year by a similar honorarium from Yale. He is a member of the American Academy of Science, and of the American Academy of Art and Science, besides being associate member of several learned societies in Europe, including the Royal Astronomical Society of Great Britain, the Imperial Academy of Sciences of St. Petersburg, and the Swedish Academy of Science.

In 1876, Professor Newcomb was elected President of the American Association for the Advancement of Science. His term expired this year, and at the annual meeting of the association, which was held in St. Louis in August last, he delivered an address on retiring from the official chair, in which the frankness of the man and the acuteness of the savant are strikingly apparent.*

PROFESSOR D. E. HUGHES.

David Edwin Hughes was born in London in 1831. His parents came from Balla, at the foot of Snowdon, in North Wales, and in 1838, when David was seven years old, his father, taking with him his family, emigrated to the United States, and became a planter in Virginia. The elder Mr. Hughes and his children seem to have inherited the the Welsh musical gift, for they were all accomplished musicians. While a mere child, David could improvise tunes in a remarkable manner, and when he grew up this talent attracted the notice of Herr

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Hast, an eminent German pianist in America, who procured for him the professorship of music in the College of Bairdstown, Kentucky. Mr. Hughes entered upon his academical career at Bairdstown in 1850, when he was nineteen years of age. Although very fond of music and endowed by nature with exceptional powers for its cultivation, Professor Hughes had, in addition, an inborn liking and fitness for physical science and mechanical invention. This duality of taste and genius may seem at first sight strange; but experience shows that there are many men of science and inventors who are also votaries of music and art. The source of this apparent anomaly is to be found in the imagination, which is the fountain-head of all kinds of creation.

Professor Hughes now taught music by day for his livelihood, and studied science at night for his recreation, thus reversing the usual order of things. The college authorities, knowing his proficiency in the subject, also offered him the Chair of Natural Philosophy which became vacant, and he united the two seemingly incongruous professorships of music and physics in himself. He had long cherished the idea of inventing a new telegraph, and especially one which should print the message in Roman characters as it is received. So it happened that one evening, while he was in the glow and enthusiasm of musical improvisation, the solution flashed into his ken. His music and his science had met at this nodal point.

All his spare time was thenceforth devoted to the development of his design and the construction of a practical type-printer, and, as the work grew upon him he became more and more engrossed with it, until his nights were almost entirely given to experiment. He begrudged the time which had to be given to teaching his classes; and the fatigue was telling upon his health, so in 1853 he removed to Bowling Green, in Warren Co,, Kentucky, and acquired more freedom by taking pupils.

The main principle of his type-printer was the printing of each letter by a single current; the Morse instrument, the only other rival then in the field in America, required, on the other hand, an average of three currents for each signal. In order to carry out this principle it was necessary that the sending and receiving aparatus should keep in strict time with each other, or be synchronous in action; and to effect this was the prime difficulty which Prof. Hughes had to overcome in his work. In estimating the Hughes Type-Printer as an invention we should never forget the state of science in those days, a quarter of a century ago. He had to find his own governors for the synchronous mechanism, and here his knowledge of acoustics helped him. Centrifugal governors and pendulums would not do, and he tried vibrators, such as piano strings and tuning forks. He at last found what he wanted in two darning needles borrowed from an old lady in the house where he lived. These steel rods, fixed at one end, vibrated with equal periods, and could be utilized in such a way that the printing wheel could be corrected into absolute synchronism by each signal current.

In 1854, Prof. Hughes went to Louisville to superintend the making of his first instrument; but the first patent for it was not taken out in the United States

until 1855. In that form straight vibrators were used as governors, and a separate train of wheel work was employed in correcting; but in latter forms the spiral governor was adopted, and the printing and correcting is now done by the same action. In 1855, the invention may be said to have become a practical success; no sooner was this the case, than Professor Hughes received a telegram from the editors of the American Associated Press, summoning him to New York. The American Telegraph Company, then the leading one, was in possession of the Morse instrument, and levied rates for transmission of news which the editors could no longer stand. They therefore took up the Hughes instrument in opposition to the Morse. A company was formed, and the lines of the smaller fry of companies—among which was the Western Union Company, then doing business on a poor scale out West—were leased. After a time they united, in 1857, with these smaller companies to form one large corporation, the Western Union Telegraph Company of to-day. They bought over the Morse instrument too, and when the monopoly was all in their hands the editors were again left in the lurch.

In 1857, Prof. Hughes, leaving his instrument in the hands of the Western Union Telegraph Company, came to England to effect its introduction here. He endeavored to get the then Electric Telegraph Company to adopt it, but after two years of indecision on their part, he went over to France in 1860, where he met with a more encouraging reception. The French Government Telegraph Administration became at once interested in the new receiver, and a commission of eminent electricians, consisting of Du Moncel, Blavier, Froment, Gaugain, and other practical and theoretical specialists, was appointed to decide on its merits. The first trial of the type-printer took place on the Paris to Lyons circuit, and there is a little anecdote connected with it which is worthy of being told. The instrument was started, and for a while worked as well as could be desired; but suddenly it came to a stop, and, to the utter discomfiture of the inventor, he could neither find out what was wrong, nor get the printer to go again. In the midst of his confusion, it seemed like satire to him to hear the commissioners say, as they smiled all round and bowed themselves gracefully off, "*Tres-bien, Monsieur Hughes—tres-bien. Je vous felicite.*" But the matter was explained next morning, when Prof. Hughes learned that the transmitting clerk at Lyons had been purposely instructed to earth the line at the time in question, to test whether there was no deception in the trial, a proceeding which would have been strange, had not the occurrence of a sham trial some months previous rendered it a prudent course. The result of this trial was that the French Government agreed to give the printer a year of practical work on the French lines, and if found satisfactory, it was to be finally adopted. Daily reports were furnished of its behavior during that time, and at the expiration of the term it was adopted, and Prof. Hughes was constituted by Napoleon III a Chevalier of the Legion of Honor.

The patronage of France paved the type-printer's progress into almost all European countries; and the French agreement with Prof. Hughes respecting it became the model of those of other nations. On settling with France in 1862,

Prof. Hughes went to Italy. Here a commission was likewise appointed, and a period of probation—only six months—was settled, before the instrument was taken over. From Italy Prof. Hughes received the Order of St. Maurice and St. Lazare.

In 1863, the United Kingdom Telegraph Co., England, introduced the type-printer in their system. In 1865, Prof. Hughes proceeded to Russia, and in that country his invention was adopted after six months' trial on the St. Petersburg to Moscow circuit. At St. Petersburg he had the honor of being the guest of the Emperor in the summer palace, Czarskoizelo, the Versailles of Russia, where he was requested to explain his invention, and also to give a lecture on electricity to the Czar and his court. He was here created a Commander of the Order of St. Anne.

In 1865 Prof. Hughes also went to Berlin and introduced his apparatus on the Prussian lines. In 1867, he went on a similar mission to Austria, where he received the order of the Iron Crown; and to Turkey, where the then Sultan bestowed on him the Grand Cross of the Medjidie. In this year, too, he was awarded at the Paris Exhibition of 1867, a grand *hors ligne* gold medal, one out of ten supreme honors designed to mark the very highest achievements. On this occasion, also, another of these special medals was bestowed on Cyrus Field and the Atlantic Telegraph Company. In 1868 he introduced it into Holland; and in 1869 into Bavaria and Wurtemburg, where he obtained the noble Order of St. Michael. In 1870 he also installed it in Switzerland and Belgium.

Coming back to England, the Submarine Telegraph Company adopted the type-printer in 1872, when they had only two instruments at work. They have now (1878) twenty of them in constant use, of which number nine are working direct between London and Paris, one between London and Berlin, one between London and Cologne, one between London and Antwerp, and one between London and Brussels. All the continental news for the *Times* and the *Daily Telegraph*, is received by the Hughes type-printer, and is set in type by a type-setting machine in the very act of arriving. Further, by the International Telegraph Congress it was settled that for all international telegrams only the Hughes instrument and the Morse were to be employed.

In 1875, Professor Hughes introduced the type-printer into Spain, where he was made a Commander of the Royal and Distinguished Order of Carlos III. In every country to which it was taken the merits of the instrument were recognized, and Professor Hughes has none but pleasant souvenirs of his visits abroad.

During all these years, the inventor was not idle. He was constantly improving his invention; and, in addition to that, he had to act as an instructor wherever he went, and give courses of lectures, explaining the principles and practice of his apparatus to the various employès into whose hands it was to be consigned.

What with this work, and his various journeys, Prof. Hughes can have had little time for original work in other directions. But very soon after the type

printer was finally off his hands, his attention was drawn to the telephone. The researches of Sir William Thompson on the variation of electric resistance in a wire subject to stress, led him to enquire whether or not sonorous waves could not be made to vary the resistance of the wire itself of the telephone circuit by stressing it, and the result of his discovery was, as every one knows, the microphone.

The Hughes type-printer was a great mechanical invention, the greatest in telegraphic science, for every organ of it was new and had to be first fashioned out of chaos; an invention which stamped its author's name indelibly into the history of telegraphy and procured for him a special fame, while the microphone is a discovery which places it on the roll of investigators, and at the same time brings it to the knowledge of the people. Two such achievements might well satisfy any scientific ambition. Professor Hughes has had a most successful career, and probably no inventor ever before received so many honors or bore them with greater modesty.—*London Telegraphic Journal.*

ARCHÆOLOGY.

THE ORIGIN OF METALLURGY—THE BRONZE AGE.

FROM THE FRENCH OF EMILE BURNOUF, BY CHRISTOPHER FALLON, A. M.

We are ignorant as to the date of the first appearance of mankind; we have no foundation upon which to rest the chronology of the primitive times. History dates only from yesterday, and yet, among the different nations, presents but fabulous origins. There is no more reality in the first facts related by Titus Livy than in the genealogies of the Grecian heroes. Adam and Eve are an agreeable myth, borrowed perhaps from Persia in the times of captivity; their descendants are the personification of families or of tribes. Grecian chronology goes back about six thousand years prior to our era, but is likewise preceded by a long mythological period. The same may be said of India and China. After all, what are six thousand years? Already have a hundred passed since the French revolution, and does it appear long to any one? Now-a-days events follow each other very fast and progress is rapid, because we possess forces, both physical and moral, of enormous power, by means of which we transform the earth and ourselves. When our ancestors possessed them not, their advances were slow, their achievements small and casual. How can the ocean be traversed, or a large sheet of water crossed without boats, and how can we construct boats if there are no tools of iron or some substance sufficiently hard to work wood, to adapt the pieces and render them imperviable to water? Let us consider the objects we make use of to-day to clothe, shelter, nourish and convey ourselves from place to place, to procure light, heat, books, and so many products of science and art

which adorn our households. It will readily be seen that there is not one which does not suppose the possession and successful employment of the metals. We are now all aware that men have not known them at all times. For a great number of years, they did not possess any, except perhaps a few grains of gold which nature spontaneously gave them, and which they collected here and there on the banks and in the channels of rivers. It was this period which has been called *The Stone Age*, and the tools those unfortunate men left behind them, as evidence of their industries and necessities, are all made of hard stone, of silex, of diorite, of obsidian and of trachyte. This long period of the infancy of man is attested by the strata in which these objects are found, buried beneath mounds of earth which have required centuries for their formation; but the actual geological period had not yet begun when man was already in existence, living among mammoths, bears in caves, and other animals now no longer to be found. In the first place it was necessary that a man, having selected a stone on which to put an edge, should strike it with another in order to scale it. Thus were the first hammer and the first hatchet made; and all other instruments being made in like manner, have given the name of *The Period of Unpolished Stone* to the era during which this rudimentary industry lasted. Little by little it was found that certain stones could by means of continued rubbing wear others which were even harder, and so friction was substituted for percussion in the manufacture of tools. In this way sharp hatchets and scissors were made; round hard stones were bored and handles inserted. Smaller stones of finer quality or brighter color were shaped and pierced and then used as beads. Arms were made in the same way. It was this second period of humanity which has received the name of *The Period of Polished or Neolithic Stone.*

From the beginning, or at least from an early date, men attempted to mould clay into uses of different kinds. This work was done by hand during the entire age of stone. The potter kneaded the clay with his fingers, the impression of which is yet seen on the pottery of those early times. It required constant observation and new means of action to enable the potter first to discover the value of the movement of a wheel, and then to construct one. In fact the turning lathe seems to have been unknown during the whole period of which we speak, but the baking of vases dates far back, for from the time that men could light fires, they observed on their hearths pieces of argil become insoluble by the heat. The black, red or yellow clay which nature furnished them in many places, enabled them to color or paint these roughly made vases; they then polished the surface, yet soft, by means of a stone burnisher, and engraved fantastic figures thereon.

Then came the first metal, which let us say was the common metal, copper. The knowledge of gold certainly preceded that of brass, because gold is found in its natural state in many countries. It, no doubt, was the same with silver the extraction of which is not very difficult; perhaps the same should be said o lead, for from the time globules of metal were found in the ashes of the fire, the man who noticed them must have wanted to know the ore from which it was

extracted, and having found it, must have sought for more in the mountains.

Substances which are producible in hearths, by the mere burning of minerals, must have been first discovered, as lead and glass; artificial glass, usually blue, is found among the objects of personal ornament of the most ancient times. On the other hand, when the extraction of a metal requires a high temperature, or a chemical operation, it may be conceded that such a metal was discovered long after the others and after a number of ineffectual attempts. Copper is found native, but in very small quantities; copper pyrites resembles gold, still the metal is obtained only by complicated operations, as is the case also with tin. Finally after obtaining these two substances, it is necessary, in order to form bronze, to make a fusion—which is attended with difficulties. The bare idea of uniting two metals does not readily present itself to the mind, and when once conceived it is yet essential to learn in what proportions they must be used in order to form a new metal more useful than either.

Bronze appeared in the West when the art of polishing stone had arrived at a state of perfection. We have in our museums, instruments of hard stone made anterior to the appearance of bronze, which our own workmen would not make better nor in any other manner; only they would probably make them faster, for they have means of action and processes which the ancients did not possess. Bronze, at first scarce, became more common in the course of time. Those fabricating it could dispose of it in other countries only in exchange for other objects of the same value, but of a different kind. These objects of exchange caused a demand which could be supplied only by discovery, or by obtaining them elsewhere in sufficiently large quantities to give rise to commerce. The discoveries of which we are about to speak have proved that the quantity of bronze kept increasing, that with this new metal many instruments were manufactured which were previously made of stone, that new ones were invented, and that a time arrived when the substitution of bronze for stone was, so to speak, complete.

The Bronze Age was, for a short time, co-existent with the period of polished stone. There is then a period of transition when these two substances were, in a measure, blended together, and might be comprised under the same title in the age of stone or in that of bronze. It would be a mistake, however, to suppose that metal caused the hard stone to disappear entirely when the superior qualities of the former were discovered, as stone continues to be used for many purposes in many countries where neither bronze nor even iron has yet supplanted it. Thus those small double-edged blades made of obsidian or silex, known as knives, still in use in the Grecian peninsula, in Asia Minor, in Palestine, and no doubt in many other countries, are fastened to pieces of wood and used by the peasants to thrash their wheat or cut their straw. They are of the same shapes as in the bronze age, and are made in the same way; but the predominance of metal over stone, and the abandonment of the latter, in most cases in which it was employed, characterize the long era which followed that of transition and which constitutes the bronze age properly so-called. In the same way that this metal was substituted for stone, it happened that a new metal concurred with bronze, and was

used instead wherever there was a decided advantage in so doing.

Discoveries which were made only twenty years ago, and which since then have been repeated throughout Europe, have enabled us to fix the period of transition from bronze to iron. It differs from that which has been called the first age of iron, and which has, for a long time, been well ascertained. During the latter, iron already takes the first rank and awaits only to be brought to a state of perfection. The transitory period is marked by a slow and progressive substitution of the new for the old metal, and by a reciprocal influence from one to the other.

Iron has not entirely supplanted bronze, as the latter is still much used, nor would aluminum and all the other metals cause iron to be abandoned; but a new substance may answer many purposes better than those that have preceded it, and for this reason be preferred. For a long time hatchets were made of stone, but were set aside when they could be made of bronze; bronze hatchets were the only ones to be found for many centuries, but were also abandoned when iron ones became sufficiently abundant to compete with them in the market. The period of transition from bronze to iron is well characterized in many ways, of which we shall speak hereafter. There is no doubt, at present, of the reality of this change, and it is even becoming apparent how this transition was accomplished, the course the metals have taken to spread from one mart to another, until they have reached the most remote countries of northern Europe; but before exhibiting these grand discoveries of our day, I must give an account of the progress which science has made in the study of ages anterior to any history.

We need not here repeat the list of discoveries relative to the Age of Stone and to the men of those primitive times. The savants of the first empire and of the restoration had denied the existence of what was then called the fossil man. Science and religion united in discrediting even the mere possibility. The discussions which arose when Boucher de Perthes announced the discovery of the remains of such a man in the old alluvia of one of the northern departments, have not yet been forgotten. His discovery was followed by the sarcasm of some and the fanaticism of others, until the day when a new generation of savants recognized their authenticity. A short time afterward skeletons of fossil men and remains of their works were found on all sides. The name of Lartet is connected with the exploration of the caverns of Perigord and Languedoc; those of Tomsen and Wilson with the prehistoric antiquities of Denmark; and that of Keller with the lacustrial habitations of Zurich. Since then Boucher de Perthes is regarded as the originator of a new science which forms the connecting link between the geology and archæology of historic times. This science, though of recent date, is always possessed of a great number of observed facts, is methodic and well defined, and its general results are already perceived. Among those who concurred in these first developments there will be found very few erudite men; they are mostly scientific men, geologists, physiologists, engineers, chemists, and perhaps amateurs who delight in this science as a pastime to beguile their leisure hours away. Texts were for a long time the only means of investi-

gation; but the most ancient texts are, in reality, modern, if they are compared with those long periods of which mankind in its infancy passed over. The most ancient Grecian authors, those who under the real or fictitious name of Homer, have bequeathed the Iliad and Odyssey, lived in the Iron age, they related events which occurred many years before, and if real, were accomplished, according to all appearances, in the Bronze age. This does not prevent the author of the Iliad, and especially of the Odyssey, to put iron in the hands of his heroes; thus the poets attributed to the past what was before their own eyes, but which the past never knew. Egypt had not yet begun to furnish these documents which are now being found; it was not known that the first four dynasties at least are anterior to the knowledge of iron in that country. The hymns of the Veda, to serve as scientific documents, should in the first place be classed according to a chronological order and referred, if possible, to certain and determinate epochs. India seems far from being able to throw any light on this subject. As to Genesis, it is known that its origin is a matter of discussion among the learned, and if some, true to their faith, attribute it to Moses, others reject its authenticity and consider it as formed by the union of two opposed traditions into one book. Be it as it may, and admitting the authenticity of Genesis, it is at least certain that its author had little knowledge of the Bronze age, and still less of the Stone age, for it is said that Tubal-Cain, the first metallurgist who is mentioned, "was maker of all sorts of instruments of brass and iron" In fine, the ancient authors cannot have had correct ideas of the primitive times, composed perhaps of decades of years, when writing was not yet in existence. It is possible there were traditions handed down from year to year, still the passage from the Prometheus of Eschylus, in which mention is made of the first men, of their living in caverns, and of the discovery of metals, is too vague to serve as a basis for scientific induction. In fact the ancients were not in a situation so advantageous as ours with regard to the past, which there were no documents to record, as they neither had the means we possess, the inumerable facts which all the countries of the world can furnish, nor the capacity of acting in concert as now throughout Europe by means of communication and typography.

The Greeks made no underground searches. The Romans robbed a great many tombs, not through love of science, but to obtain the valuable objects therein, which have been reburied or have disappeared with them. The Roman church which followed the empire has never favored the positive sciences. The Middle ages were taken up with metallurgy, but their end was that of King Midas; the philosopher's stone was to convert all the metals into gold. The modern spirit, which may properly be called the scientific spirit, after having learned with Bacon and Descartes its real rudiments, has steadily advanced in a series of discoveries. Possessed of the abstract sciences, it has been able to unite conjecture with reality, and found natural philosophy and chemistry.

It then gave birth to that new study, whose subject is human beings; to the physiology of plants, of animals, and finally to the science of man, of which prehistoric archæology forms the first chapter.

Farmers and workmen had for a long time known of the existence of instruments of bronze, and had gathered and sold them before the savants thought of collecting them and organizing a museum. The first collection made was that at Copenhagen. It was Tomsen, who as early as 1836, classified all objects dug from the dolmens, barrows and mounds of Denmark, and founded the Museum of Northern Antiquities, the finest prehistoric collection in Europe. A certain Swede, Sven Nilsson, profiting by Tomsen's work, and by his own knowledge of the barbarians of Oceanica and of other countries not yet civilized, united their industrial works with those of the ancient Danes, and from 1838 to 1843, introduced the study of comparative ethnology. It is not to be supposed that the savages of to-day are descendants of the ancient inhabitants of Europe, but their ways of life are the same, and they make use of the same means to satisfy their wants. There now exist colonies which do not know the use of metals, or which obtain them in small quantities and look upon them as objects of personal ornament; they have nothing to exchange in commerce with the rest of the world.

It was Tomsen and Nilsson who distinguished the stone age from the bronze age; they had found in the northern countries a certain class of tombs in which, besides skeletons and rough pottery, objects of stone are found, but there were no traces of any metal. In others bronzes were found to have served the same purposes as stone, and to have been substituted. In others again appeared articles of iron almost similar in form to those of the bronze of the other graves. It is evident that if the men of the first period had had bronze, they would have used it in preference to stone, while those of the second would have put aside bronze for iron.

Thus the first distinctions of the prehistoric ages were established, and in succeeding years were confirmed. Two years after, M. Worsaae, a Dane, in his book on the ancient times of Denmark, set to work to explain the numerous discoveries of the bronze age made in his country.

Switzerland ranked next. In 1853 there were found in the lake of Zurich, and shortly after in the other lakes of that country, dwellings built on stakes driven in the ground, which have received the name of *pallafittes*. With this discovery of great scientific value, we find the name of Dr. Keller associated. It confirmed those made in Denmark and Switzerland ten years previously. These houses were not situated along-side of each other, but superposed, and presented the three Prehistoric ages Among the ruins of the upper layer was found iron mingled with bronze; in the middle layer just beneath, bronze only, together with objects of stone which the metal had not yet replaced; and lastly, in the lower layers on the bottom of the lake were found articles of stone only, without any metal whatever. At the same time the progressive march of civilization was noticeable by the excellence attained in the art of moulding either pottery or metal. There was no longer doubt as to the succession of ages, nor as to the essential character of each. The lacustrial habitations of Switzerland proved that these three periods of ancient civilization were not confined to the North, but were spread in more central countries.

That same year (1853), was favorable to the prehistoric sciences. While M. Keller was sounding the lakes of Switzerland, there was discovered at Villanova, near Bologne, a necropolis, which has been termed, perhaps not entirely correct, proto-Etruscan. It was examined and described with exceeding care by Count Gozzadini, who made it known the following year, and who has since then made numerous other discoveries. The nature of the objects found in that cemetery showed that it belonged to a time posterior to the last period of bronze, but anterior to the Etruscans, with whom its dead had till then been confounded. It was after the discoveries of Villanova, that *the first Iron age* was assigned a place in science; this age had followed the period of transition from bronze to iron, corresponding to the upper layer of the palafittes, and had perhaps immediately preceded the Etruscan period, which extended down to historical times. Thus the past and present of man seem to be connected by a series of links, so to speak. Archæology is properly a branch of history, and is probably the most substantial part, as it is founded on real facts and not on mere reports often altered and sometimes falsified. Its commencement is connected with prehistoric studies, as the three Prehistoric ages are connected two by two in their order of succession. In ascending from age to age, you arrive at the period of unpolished stone; beyond that there is probably a long term of years ending with man of the quarternary, may be of the tertiary period; that is to say, with the geological epochs prior to the one in which we live. It is at this stage of science that theories begin, as those of Darwin on the origin of the human species and its animal forms which have preceded and followed it.

In 1857, M. Troyon, in publishing the discoveries of Keller, called attention to the problem regarding the origin of bronze; but to solve it, it was necessary that a science as yet of recent date should be further developed by new facts and throughout many countries. After Switzerland, Savoy and Italy made the largest contributions to the study. In lake Varesa, in 1863, Messrs de Mortillet, Desor and Stopani recognized the period of transition from the age of stone to that of bronze. The pallafittes were noticed only in later years around the fortress of Peschiera.

Since 1862, Messrs. Strobel and Pigorini have found not far from Parma, deposits of loam, known to husbandmen as *terramares*, and therein detected the remains of the old lacustrial habitations; in fact the stakes still remained, and were surrounded by organic matter; from the appearance of the alluvium it was evident that water had remained in the low portions of Emile, and that formerly there had flourished a civilization identical to those of the Swiss lakes.

We cannot here cite the names of all those who, since 1860, have contributed to the advancement of prehistoric studies, but their number has increased in proportion as the increasing interests of research extended, and a method of procedure was adopted.

In 1862, Napoleon III founded the museum of St. Germain, which was established for the purpose of collecting the Gallo-Roman antiquities.

The number of books and memoirs relative to the ancient ages and particu-

larly to the bronze age, is considerable. There are very many public and private libraries throughout Europe, so that it is next to impossible for one man to visit them without devoting much time and money. The need of statistics, as full as possible to give all the learning available to aid in future discoveries, was felt. The demand was supplied by M. E. Chantre's admirable work entitled the *Bronze Age.* In one of the three volumes of which it is composed, there are only tables in which are classed in methodic order, all the objects of the bronze age found in France and Switzerland, with indications of their origin and where they can be seen to-day; there are at present almost 33,000 specimens. The other volumes contain much information of the other parts of Europe from which objects of bronze were gathered. If a work similar to that of M. Chantre was devoted to each of them, it might be easily believed that the conclusions of this savant would be confirmed, as they are founded on a thorough knowledge of all European collections, although his original intention was to have merely given statistics. As no work of this kind had yet been published on the Prehistoric ages, it is to be expected that this one will form an epoch in the science and will be a starting point for new discoveries to begin.—*Van Nostrand's Magazine.*

MUMMY HEADS AND EGYPTIAN ANTIQUITIES FROM THEBES.

"So Joseph died, being a hundred and ten years old; and they embalmed him, and he was put in a coffin in Egypt." This event recorded in the Book of Genesis, happened sixteen hundred and thirty-five years before Christ, or, from the present day, three thousand five hundred and thirteen years.* The contemplation of this lapse of time strikes the mind with a great feeling of awe, and the human intellect staggers at its contemplation; yet it is possible that the head of the mummy which is now before me, steadfastly gazing at me with an expectant, mournful, yet pleasant smile, may be that of a human being, a contemporary of Joseph.

This magnificent specimen has been most kindly presented to me by my friend Mr. Douglas Murray, who, with other relics, brought it from the tombs of ancient Thebes. Thebes was the original metropolis of Egypt, and was in the height of its glory about sixteen hundred years before Christ. The ancient kings of Egypt lived here; the headquarters of the army were here; the sacred temples were here, in which the Egyptian priests performed the high ritual of worship to their gods, typical of the powers of nature, such as Ra (the sun), Amen Ra (the universal power), Neith (Minerva), Thoth (Mercury, the god of knowledge and reputed inventor of writing), Sothis (or the Dog Star), Osiris (the judge of the dead), his wife Isis and their sons, Horus and Anubis; and here, too, it may be possible that Moses was instructed in the wisdom of the Egyptians by Harnetaft, the high

* This date is taken from "Cassell's Bible," where there is a capital engraving of the body of Joseph about to be placed in a mummy case.

priest, and by Tenamen, the incense-bearer, whose mummies are now in the British Museum.

This mummy head was brought from that wonderful Egyptian cemetery where begins, as it were, the City of the Dead, which, with its grand natural approach, has been so ably described by Mr. Douglas Murray himself in this journal of August 22, 1868, No. 135:

"In this magnificent gorge the rocks seemed at times to almost meet above our heads. Along the ancient causeway, and at each side of us rose vast masses of sandstcne, piled as if by the hands of giants in confused heaps of fantastic outline. At the end of the valley and facing us, rose to a great height a pyramidal mound of extraordinary configuration, while occasionally a solitary eagle, circling far aloft in the sunny expanse of blue sky, made up a picture grander than Salvator Rosa in his most inspired moments ever transferred to canvas, and which might have been the original for one of Gustave Dore's gigantic and gloomy conceptions. Fit scenery, sufficiently weird, silent and mysterous for the repose of Egypt's greatest dead.

"We presently found ourselves at the entrance to a staircase which evidently led deep into the heart of the mountain. Down these steps, after lighting our pine torches, we carefully descended until we reached a series of chambers, which, once tenanted by a king, has since been designated 'The Harpers' Tomb.' Situated at a short distance from Belzoni's, this wonderful underground palace is certainly next, also in point of interest, to that most celebrated of all great sepulchers. The name is derived from the fact that in a compartment of the tomb are represented two minstrels playing harps, built in exactly the same shape as our model 'Erards,' which are ornamented with gilding, and surmounted each with the head of a sphinx. One of them has as many as thirteen strings; and this sufficiently proves that the ancient people were highly advanced in the cultivation of music, in that respect differing widely from the modern Arabs, whose songs, though very quaint and often pretty, are all of them in the minor key. This minor key, the language of nature, seems a necessary accompaniment to the music of every uneducated and semi-barbarous people. In the compartment which contains the harps and harpers are, scattered in groups, many musical instruments of highly finished workmanship and elegant design, while through the corridors and side chambers are pictures of rich furniture—sofas with crimson seats and gilt supports in the form of lions' feet, spears, shields, daggers, armlets, and the varied accouterments of a warrior.

"Leaving this vault, with the history of its date legibly impressed upon its walls, we descended again by stairs and shafts let into the midst of the sandstone ridge, to several of the royal vaults, all fresh and bright under the red glare from our torches, but we had still to reach the mummy pits, where one may walk through rows of those dark brown Egyptians, swathed in their fine linen cloths, and redolent of the spices wherewith they were embalmed—sight and smell, no doubt, wholesome and salutary to a Capuchin monk, but unpleasantly suggestive to most mortals. The vast charnel house into which we now descended was

crawling with antiquities and alive with bats. A shot from a saloon pistol caused the death of seven of these perverse dispositioned cheiroptera, who beat their ill-omened wings in our faces, clung to the brims of our wide-awake hats, and were slaughtered by swarms in a general "battue.' This, one of the great tombs of *Assaseef*, was covered far underground with sculptures in relief. We were lowered by ropes into chambers beneath, still sculptured, until at length, heartily tired with bats and bad air we returned once more to the light of heaven

"In a rock cavern, where candles burnt blue in the stifling heat, we succeeded in tackling an Egyptian lady, who was carefully brought to light and solemnly unswathed. Her chignon of curly black hair, together with a foot of remarkably high instep, are still to be seen in the cabinet of a collector. In this tomb we found a few blue porcelain figures of mummies represented in the character of Osiris, their great judge and god of the dead, with flail and scepter, the symbols of retribution and power. As we retreated with our female mummy attached to a cord, a large portion of the roof fell in—for the tomb was simply rough hewn in the rock—and the sand, closing in on the mouth of the cave, all but barred our exit, and would probably effectually shut the entrance to future travelers who might wish for a specimen of early embalming. The Arabs in the neighborhood have so little respect for their ancestors that they are in the habit of using them as firewood. The cloth, soaked in bitumen, burns very readily, and the body gives out a good flame, which is found useful for cooking, when there happens to be anything to cook. This great custom of the modern Thebans puts the funeral institutions of the Romans completely into the shade, for although the Romans burnt their dead, they never thought of turning them to any account for culinary purposes,"

Again, on Belzoni's tomb, which is perhaps the noblest of all, we find the best and richest coloring. "The four square pillars of the first hall beyond the pit are decorated like the whole of the walls. On them are painted female figures, nobly proportioned, and of great beauty. Their robes of blue, purple and scarlet colors, fastened with gold clasps, are magnificently embroidered with ornaments, and their heads crowned with elaborate tiaras of enameled work. In this chamber Horus, son of Osiris, the deity of good, is seen crushing beneath his feet and stabbing with a spear, the giant serpent of evil, Aphophis, with his numberless folds and human head, proving to one's mind how widely spread are all the numerous primitive traditions."

The head of this mummy is probably that of one of the ancient aristocracy of Thebes. I judge so from the evident care which has been taken in its preparation. From the general contour of the head, I have come to the conclusion that it is that of a female. The forehead is somewhat receding and narrow; face rather projecting, of pure Egyptian type, viz., head small, low and narrow. The actual features cannot be seen, as they are covered, as it were, with a mask. Linen bandages are placed round the neck like an old fashioned white neckcloth. These are then brought up from the back of the head in a figure-of-eight fashion, and are made to envelop the whole back of the head. This is the work of a very clever

artificer. The bandages are made of linen of about the same substance as those now used at St. George's Hospital. Underneath this linen mask can be plainly seen the outlines of the face; the pupils of the eyes are marked in with a black spot, and the eyelashes (also marked in) are united together at the external part of the eyes, the lines being prolonged on to the cheeks. The eyebrows unite over the bridge of the nose, and follow the contour of the prolonged eyelashes below.

About an inch above the eyelashes we see a narrow cord, or band of linen —a sort of fillet, which, starting at the back of the neck, is brought up in a graceful curve over the ears, and again to the back of the head.

This mummy, I am delighted to say, wears a wig. We found the whole head covered with what at first sight appeared to be rolls of hair, but which, on examination, turned out to be imitation hair formed of little curl-like rolls of a material which looks like fine canvas. The rows forming this wig are arranged in three tiers, one above the other, and gracefully overlapping each other. The lowest tier begins from the top of the ear and runs almost straight across the forehead. It is not at all unlike the fashion of hair as worn by some ladies of the present day. To try the effect, I have put a modern smartly-trimmed hat on the head of this Egyptian lady. I see that the fringe of the hair is the same as the fringe of the present time. On the whole, there is a little more *chic* about it. The tips of the ears and the lips are covered with a dark red pigment, which I find is soluble, and comes off with the finger, even after the lapse of so many thousand years. Another idea. I have washed a side of the mummy's face with warm water and a sponge, and, having again put on the smart Regent Street bonnet, am more convinced than ever that this is the head of a lady. The damping of the linen cloth has given quite a different and almost life-like appearance to the features; altogether, the lady looks very good-natured and smiling.

This application of moisture brings out the fact that the red material is not only on the ears, bnt also at the corner ot each eyelid and on the nose. I cannot make out what has become of the lady's hair. I therefore dissected off some of the bandages of the back of the head, and then identified the bitumen which surrounds the skull. In this I find several little short hairs. I therefore consider that the head was shaved in order that the wig might fit the contour of the head gracefully, which is certainly does. Wigs appear to have been commonly worn by the Egyptians. In the British Museum there is a most splendid wig, Also, in another case, articles of dress and appliances for the toilet, such as a leather dress, a linen shirt, and a box to hold clothes, combs, hair-pins, ointment vases, and apparatus for painting the eyes with stibium, bronze mirrors, and a collection of shoes and sandals.

I cannot find any marks of gold about this Theban lady's head. It appears, however, not to have been an uncommon practice to gild the nails of the fingers and toes of female mummies. I have in my collection the foot of a mummy, on the sole of which there are very substantial traces of gold. It may interest our readers to know the mames of Egyptian ladies, which I have picked out from

various sources. They are as follows: Bochoris, Catbti, Tphous, Shepshet. I wonder what was the name of the lady whose head I now possess?

The word mummy is derived from an Arabic word, Mum, signifiying wax. Herodotus, a very great observer, and evidently a great note-taker, has been good enough to record many interesting details relative to the process of embalming as carried out by the Egyptians. It appears that there were professional embalmers, whom the relatives of the deceased consulted as to the style of mummy. "They show the bearers of it wooden models of bodies, painted in imitation of reality. They say that the most expensive of them is His, whose name I will not in such case mention. They exhibit also a second model, inferior to the first, and cheaper than it; and a third, the cheapest of all. After this explanation, they ask the bearers of the dead body after which model they wish it to be prepared, and they, having agreed upon the price, depart." "His" implies Osiris, who was the Jehovah, the great God of the Egyptians. This name was held in the highest awe.

Herodotus then gives us the prescriptions used in the different kinds of mummy making. In the most expensive process, powdered myrrh, and cassia were used. The body then was pickled in a solution of natrum (carbonate of soda) for seventy days. In mummy making, Jew's pitch, *Bitumen Judaicum*, was used. This is nothing more or less than the asphalt now used in making the London pavements. The bandages appear to have been always linen, several feet long, differing, however, in the fineness of texture.

On reverting to the head since it has been wetted, I find that what appeared to be bandages over the face are not so, but simply a linen mask in one continuous piece. This mask has evidently been applied wet to the face, and has been pressed down into the depressions of the features, so that the likeness of the person is apparent. I find also that the nose is considerably depressed on the right-hand side. This is a curious phenomena, for which I cannot account, but in relation with it must be considered a fact that on the left side the head is covered with sand of a reddish color. This may be the sand of the desert.

One of the most perfect mummies I know of is a very old friend of mine. It is that of Horseisi, an incense-bearing priest of Ammon. He is now at the Royal College of Surgeons, Lincoln's-inn Fields.

"Mr. Pettigrew informs us that Mr. Clift, the intelligent conservator of the museum, suspected that there had been a fracture; and upon removing a portion of the scull this was found to have been the case. The occipital bone had been broken, and on the inner surface an exudation, or rather deposition of bone, extending upward of one inch in length, was found to have taken place, thereby marking the process of nature in repairing an injury of the frame."

Besides the head of this Theban lady, Mr. Douglas Murray has given me a mummy crocodile. The sacred animals of the Egyptians were as follows: Cats, jackals, cynocephali, bulls, rams, the ibis, snakes, fish, crocodiles. They seem to have had a special veneration for the crocodile. The reason for this, as suggested by Mr. Douglas Murray, is obvious. Crocodiles must have water to exist.

Water in Egypt is of the highest importance for drinking and watering fields. If the canals were neglected the crocodiles would die. The people, therefore, were kept in order under a superstitious awe for the crocodiles, but it really was an artful dodge of the authorities to keep the water supply of the country in good order. The crocodile is about 22 inches in length. The right fore paw is placed over the right eye; the left fore paw is tucked under the chest. There is an appearance on the lower jaw as though it had at one time been slightly covered with gold. This crocodile was carefully wrapped up in linen cloth. My friend, Mr. Fred Wiseman, the well-known yachtsman, discovered in the linen bandage which surrounded the crocodile's tail a knot used every day at the present time by yachtsmen. Another interesting specimen found in a mummy tomb is a portion, about two inches square, of some substance which looks like amber. It is not, however, amber : its real nature is unknown. My own idea is that it is adipocere, a substance into which human bodies are not unfrequently converted, as I know so well from the discoveries I made when searching for the body of John Hunter in the vaults of St. Martin-in-the-Fields.

Among the relics brought me from Egypt at the same time with the mummy head are various specimens of old pottery from Dendera and the temple of Kom-ombo; a very beautiful alabaster pot from one of the tombs at Thebes; also a very curious natural formation in flint from the mountains which flank the Nile. Two portions of papyrus plants were also in the parcel. From the word papyrus our English paper is certainly derived. The papyrus used to be made from the stalk, which was divided longitudinally into long thin flakes. These were placed side by side, and others put across them to strengthen and unite the papyrus. There are also numerous specimens of Nile fish collected at the same time with these other Egyptian curiosities. Among these are some heads of the large siluris and the head of a fish with some most wonderful lancet-shaped teeth. I cannot sufficiently thank Mr. and Mrs. Douglas Murray for bringing me home these interesting relics, which form a very valuable addition to my collection.—FRANK BUCKLAND, *in Land and Water.*

METEOROLOGY.

MISSOURI WEATHER SERVICE, NOVEMBER, 1878.

BY PROF. FRANCIS E. NIPHER, WASHINGTON UNIVERSITY, ST. LOUIS.

November, 1878 has been warm and dry. At the central station the mean temperature has been 46.4° (normal 42.9°), the extremes being 30° on the 1st and 71.5° on the 6th. Englemann has observed Novembe. temperatures of 0.5° (1845) and 81.5° (1837).

The rainfall has been 1.02 inches—the normal being 2.95. The extreme

November rainfall in 39 years is 0 in 1865, and 11.55 in 1876. Twice in 39 years has the November rainfall been less than during November, 1878. In the State, the rain has been greatest in the southeast, reaching 3.60 at East Prairie (south of Charleston). The entire western part of the State has suffered from excessive drouth. Streams have dried up, and forest and prairie fires have raged. At Forsyth the monthly rain was only 0.08 inches. On the 30th an interesting storm came in from the northwest, covering the northern part of the State with snow. Prof. Lovewell reports this storm as passing Topeka, Kansas, at 7 A. M. Twelve hours later it reached St. Louis. Thunder was observed at Neosho during its progress there.

On the 18th an earthquake was felt over the southern and eastern part of the State, the shock having been felt as far north as Hannibal, Macon and Kansas City. At Glasgow the shock was quite severe. The shock was also felt as far south as Memphis, Tenn. and Little Rock, Ark.

We shall try to collect information for a special bulletin on this subject, and solicit information from any one who can give it. If possible, the time of the occurrence (in local time or the time of some known locality); the direction of vibration (swaying of chandeliers, etc.); and all observed effects should be given. State also how generally it was observed in your locality.

KANSAS WEATHER REPORT FOR NOVEMBER, 1878.

BY PROF. F. H. SNOW, OF THE KANSAS STATE UNIVERSITY.

The warmest November on our 11 years record. Mean temperature 45.87°, which is 7.06° above the average November temperature of the 10 preceding years. The mercury fell below freezing point on only three days, The highest temperature was 72°, on the 5th; the lowest was 22°, on the 8th; range of temperature, 50°. The mean at 7 A. M., was 38.55°; at 2 P. M.. 55.83°; at 9 P. M., 44.52°.

Rain and melted snow, 1.55 inches, which is 0.23 inches below the November average. Rain fell on seven days, Snow fell on the 30th to the depth of two inches. The entire rainfall for the eleven months of 1878 now completed, has been 36.50 inches, which is 3.24 inches above the average for the same period for ten years.

Mean cloudiness, 42 per cent. of the sky, the month being slightly clearer than usual. The number of clear days was 17 (entirely clear 6); half clear, 3; cloudy, 10 (entirely cloudy, 3). Mean cloudiness at 7 A. M., 42.33 per cent.; at 2 P. M., 46.66 per cent.; at 9 P. M., 37 per cent.

Wind.—N. W., 34 times; S. W., 19 times; N. E., 14 times; S. E., 13 times; N., 7 times; S., 3 times. The entire distance traveled by the wind was 11,198 miles, which gives a mean daily velocity of 373 miles, and a mean hourly velocity of 15.55 miles. The highest velocity was 40 miles an hour, on the 27th.

Relative humidity:—Mean, for the month, 62.6; at 7 A. M., 76.9; at 2 P. M., 40.9; at 9 P. M., 70.2. Greatest, 97.3, on the 10th; least, 18.2, on the 57th. Mean at 7 A. M., 76.9; at 2. P. M., 40.9; at 9 P. M., 70.2. There was one fog—on the 7th.

MEDICINE AND HYGIENE.

MILK AS A VEHICLE OF CONTAGION.

BY ALEXANDER R. BECKER, M. D., BERKELEY, CALIFORNIA.

Among the many questions now agitating the scientific world there is, perhaps, no one of more vital importance than the Germ Theory of Disease; and, up to the present time, at least, the most important application of this theory has been to the so-called zymotic diseases. These diseases are also attracting close attention on account of the fearful ravages caused by them, every year, in our cities, as well as in the rural districts. Any light which can be thrown on their origin and spread must, therefore, be hailed with satisfaction.

There is one source which we think has not been sufficiently insisted upon, although it has attracted more attention in England than in this country; and that is *milk*. How many householders ever think of inquiring where their milk-supply comes from, or what are the sanitary conditions of the farm or dairy whence it comes? In several of the States there are "milk laws;" and some of our large cities have "milk-inspectors," who examine the milk, more or less carefully, for "adulterations." But no care of chemical or microscopical analysis can discover the infinitely more dangerous disease-germs or contagia. If the disease-germs be present in the water which supplies the dairy they will surely get into the milk, either innocently, through the necessary washing of the cans, or wrongfully, through intentional "watering." Or, if they should be present in the atmosphere, they would naturally be attracted and absorbed by a fluid so rich in nitrogen and water; which would also afford them a pleasant resting-place until, by its consumption, they could reach an appropriate nidus.

In England, several epidemics have been directly traced to the milk which came from dairies where the water-supply was found to be contaminated. In one case—at Bolton—forty-seven out of fifty families supplied from the same dairy were smitten with typhoid fever. On examination, the water-supply of this dairy was found to have been polluted by the dejections of a typhoid-fever patient.*

When we remember the utter carelessness which prevails in the country generally, on the subject of drains and privies, and their position relative to brooks

* See paper by Dr. John Dougall, Medical Officer of Health for the Burgh of Kinning Park, Glasgow; *Glasgow Medical Journal*, May, 1873, p. 312. Also, "Eighth Annual Report of the State Board of Health of Massachusetts," 1877, p. 122.

and wells, we must stand appalled at the resultant danger. And here we find a very probable origin of many of our city epidemics. Moreover, we see that, in order to make our milk-laws and milk-inspection effective, they must be extended so as to cover *all* milk-farms, with their dairy buildings, systems of sewerage, and water-supply. This would of course be very unpopular with the farmers, and would entail considerable expense, as it would largely augment the labors of the State Board of Health

But, if the people could be brought to see (1) the enormous death-rate from the contagious fevers; (2), the great danger of drinking milk containing contagia; and (3), the strong probability of such contamination of their milk-supply, owing to their ignorance and carelessness of dairymen, public opinion would soon demand the passage and strict enforcement of such preventive measures.—*N. Y. Medical Journal.*

Seven Good Rules for Preserving the Eyesight.—Dr. H. C. Angell, in his little book on "How to take Care of our Eyes," recently published in Bosion, gives the following rules to be carefully observed by all persons who have a tendency to weakness of sight, or who experience unusual fatigue of the eyes in reading or other occupations requiring close use of the eyes:

1. Cease to use the eyes for the time being, and look away from the work when sight becomes in the least painful, blurred or indistinct. After perfect rest for a moment or longer, work may be resumed, to be discontinued as before when the eyes feel again fatigued.

2. See that the light is sufficient and that it falls properly upon your work. Never sit facing it. It is best that the light should fall upon the work from above and behind. Failing this, it may fall from the side. Never use the eyes at twilight. Any artificial light for the evening is good if it is brilliant enough and steady. When artificial light is at all painful, it is safer to read or write only during the day.

3. Never read in the horse or steam cars. It requires too great an exer tion of the accommodative power to keep the eyes fixed on the letters.

4. Never read when lying down; it is too fatiguing for the accommodative power. Many a tedious case of weak sight has been traced to the pernicious habit of reading in bed after retiring for the night.

5. Do not read much during convalescence from illness. Before the muscular system generally has recovered its healthy tone, we ought not to expect the muscles of accommodation to bear the continuous use to which they are subjected in reading or writing. We cannot be sure that the delicate muscles of the eye are in a condition to be used until the muscles of the leg and the arm have regained their strength and firmness.

6. The general health should be maintained by a good diet, sufficient sleep, air, exercise, amusement, and a proper restriction of the hours of hard work.

7. Take plenty of sleep. It is a sovereign balm for those who suffer from weak sight. Retire early, and avoid the painful evening lights. Ten hours sleep for delicate eyes is better than eight.—*Boston Journal of Chemistry.*

The Prime of Life.—Between the ages of forty-five and sixty a man who has properly regulated himself may be considered in the prime of life. His matured strength of constitution renders him almost impervious to an attack of disease, and experience has given soundness to his judgment. His mind is resolute, firm and equal; all his functions are in the highest order; he assumes mastery over his business; builds up a competence on the foundation he has laid in early manhood, and passes through a period of life attended by many gratifications. Having gone a year or two over sixty he arrives at a stand-still. But athwart this is the viaduct called the turn of life, which, if crossed in safety, leads to the valley of "old age," round which the river winds, and then beyond, without boat or causeway, to effect his passage. The bridge is, however, constructed of fragile material, and it depends how it is trodden whether it bend or break. Gout and apoplexy are also in the vicinity to waylay the traveler, and thrust him from the pass; but let him gird up his loins and provide himself with a fitter staff, and he may trudge on in safety and with perfect composure. To quit metaphor, "the turn of life" is a turn either into a prolonged walk or into the grave. The system and powers having reached the utmost expansion, now begin either to close like a flower at sunset or break down at once. One injudicious stimulant, a single fatal excitement, may force it beyond its strength, whilst a careful supply of props and the withdrawal of all that tends to force a plant, will sustain it in beauty and vigor until night has entirely set in.—*Sanitarian.*

LIFE WITHOUT AIR.

The *Journal fur Prakt. Chemie* gives a detailed account of experiments instituted by Professor Grunning, of Amsterdam, to settle the question as to the ability of bacteria to exist in media free from oxygen, a doctrine which has been warmly advocated by Pasteur. He made use of ferrocyanide of iron as an exceedingly delicate test for oxygen, and by the use of this re-agent detected oxygen in the apparatus and media which are generally employed for cultivating micro-organisms, and which have hitherto supposed to have been free from air. The experiments consisted in inclosing in glass tubes easily decomposable substances, such as raw flesh, green peas, etc., infecting with a drop of a mixture of decayed peas and white of egg, which contains nearly all varieties of bacteria, and closing the tubes by fusion after carefully freeing entirely from oxygen. The sealed tubes were exposed to a temperature of about 100° Fah. A considerable number of such vessels have been kept two years without the contents having suffered any change, as, on opening, they were found to retain their original freshness. The result of these experiments appears to show, contrary to Pasteur's views, that, by the exclusion of oxygen, bacteria are completely destroyed, and putrefaction, being arrested, does not continue afterward on the admission of filtered air free from bacteria.

FUMIGATION IN ASTHMA.—At a meeting of a medical society in Philadelphia, Dr. W. M. Welch called attention to his treatment of asthma by fumigation. The powder to be burned is composed of two and one-half parts of nitrate of potassium, one-half part of belladonna, and five parts of powdered stramonium leaves, intimately mixed with a small proportion, say one-half part, of pulverized white sugar, the latter being added to prevent the compound from burning too freely. The saltpeter may be disolved in just enough water to make a saturated solution, which is mixed with the leaves, and subsequently dried into a coarse powder, and sugar added. A small quantity is placed on a brick or tin plate and ignited, when it burns, giving off a cloud of smoke. He had occasionally spread sheets over a clothes-horse for the purpose of confining the fumes, and had obtained very satisfactory results during paroxysms of asthma.—*Boston Jour. Chem.*

BOOK NOTICES.

ORATORY AND ORATORS, by William Mathews, LL. D., Chicago; S. C. Griggs & Co., 1879. pp. 456. 12 mo. $2.00.—For sale by M H. Dickinson.

Professor Mathews is one of those fortunate writers who, despite their rapidity of production, can maintain their *prestige* with readers of all classes. He produces at least one book a year, but instead of palling upon the tastes of the public, each successive work is greeted with increased enthusiasm.

The above named volume has been promised by the publishers for several months past, and it is but justice to them to say that in every respect it comes up to the expectations excited by their announcement.

The arrangement of the work is natural and logical, and the general treatment of the special topics, admirable. While the style of the writer is easy and graceful, it is evident that prodigious labor has been expended in examining, comparing and selecting from many and various sources the materials used in illustrating the many points made. Beginning with a brilliant chapter upon The Power and Influence of the Orator, he holds the reader's close attention while he discourses ably and eloquently upon the Qualifications of the Orator, the Orator's Helps and Trials, and the Tests of Eloquence. To these and kindred topics he devotes eight chapters, full of most valuable and practical suggestions to speakers of all classes, young and old, and teeming with apt illustrations and appropriate quotations. The remaining six chapters are devoted to vivid sketches of the principal political, forensic and pulpit orators of England, Ireland and America. These sketches are exceedingly well done, and, aside from their fitness as illustrations of the subject in hand, are most interesting and life like portraitures of most of the distinguished orators of this and the preceding century.

It is a book that will please and instruct all, but at the same time it is one that is difficult of description, and requires perusal to be appreciated. Suffice it to say that it is a most fascinating work, based upon extensive and accurate knowledge, and built up with most attractive art and skill.

Zoology of the Vertebrate Animals, by Prof. Alexander Macalister, M. D.; Henry Holt & Co., N. Y., 1878. 12 mo. pp. 134. 60 cents.—For sale by M. H. Dickinson.

This is another of the excellent series of *Hand-books* in various departments of science now in course of publication by Henry Holt & Co. While they are small and brief works, they are written by authors of profound learning and established reputations for especial familiarity with the subjects they treat, and are just what is needed by readers who have not the time necessary to cull the desired knowledge from the extensive and exhaustive works of technical writers.

The little book under consideration may be read in two hours, and yet it is the careful and precise work of a distinguished professor of zoology and comparative anatomy in the University of Dublin, revised with especial reference to American readers by Prof. A. S. Packard, Jr., one of the ablest and most skillful naturalists in the United States, so that its teachings may be implicitly relied upon as the latest and most exact revelations of science. It gives in less than one hundred and fifty pages a comprehensive and systematic account of the leading characters of the vertebrata in a style devoid of technicalities and adapted to the general reader.

The whole series will comprise similar brief works on architecture, art, astronomy, physical geography, botany, chemistry, literature, music, physics, political economy, &c., making, as a whole, a most valuable pocket library for students in school, or for those older persons whose knowledge on such subjects needs a little jogging and revising.

The Blessed Bees, by John Allen; G. P. Putnam & Son's, New York, 1878. 12 mo. pp. 170. $1.00.—For sale by M. H. Dickinson.

When Pausanias, some 1700 years ago, described in glowing terms the bees and honey of Hybla and Hymettus, it is reasonably certain that he did not foresee that in 1878 the citizens of the United States would be improving their honey, and "Italianizing" their honey-makers, by introducing among them the descendants of those self-same bees of Hybla. Yet such is the case, and we prosaic time serving Americans, now eat, without remark, identical sweets with those produced from the flowers which perfumed the air and bedecked the craggy sides of Mount Hymettus.

The work before us is an account of a year's work with bees in Michigan, during which time, upon an outlay of $1,600 (of which $830 was a permanent investment,) a clear cash profit of 360 per cent. was made, or, counting gain in stock by natural increase, 454 per cent.! These are surprising figures, but to any one who reads the book they are made plain as daylight. In addition to this the whole subject of bee-keeping is fully, clearly, and entertainingly discussed. While every man cannot become a successful bee raiser, it is made quite evident that there is "money in it" to careful, painstaking persons, who will pursue the business intelligently and faithfully, and to such persons we can conscientiously recommend Mr. Allen's little work.

HISTORY OF THE CONFLICT BETWEEN RELIGION AND SCIENCE, by John William Draper, M. D., LL. D ; D. Appleton & Co., N. Y. Eighth edition. pp. 373. $1.75.

This is the twelfth number of *Appleton's International Scientific Series*, and one of the best of the list. Professor Draper, as usual with him, exhausts the whole subject, so far as history is concerned, and while all may not accept his conclusions, no one can refuse to admit his facts and the careful and untiring research manifested in every chapter. He has spared no pains in collecting materials. Grecian, Roman, Egyptian, Jewish, Mohammedan and Hindoo history have all been made to contribute to this discussion, and no one, no matter what may be his particular beliefs, can lay the book down after reading it, without a consciousness of having acquired additional information and an enlarged liberality of ideas upon the conflict between religion and science.

The work is for sale by M. H. Dickinson of this city, whose stock of scientific books is really wonderful in its completeness; equal to any metropolitan establishment anywhere. More recently, to meet the demand, he has added scientific instruments, such as microscopes, field and opera glasses, engineer's cases, globes, graphoscopes, &c. Of rare specimens of the book-maker's art, we have never seen excelled a ten volume edition of Shakespeare, bound in Russia leather, copiously annotated and printed in the most readable type imaginable. It is a gem of itself, but is surrounded by the most elegant works, displaying the rare skill of the Harpers, Appletons, Osgoods, Houghtons and other artists in bibliopegia. At the same time Christmas goods in the most ornate and ingenious styles, from a superb jewel case to a steam doll baby, load the counters.

SCIENTIFIC MISCELLANY.

THE MEAT MINES OF SIBERIA.—It has often been stated that the inhabitants of Polar Siberia feed their dogs on mammoth meat preserved in nature's ice house and sliced off at the convenience of the dogs. How these tropical animals came to be so near the pole is an unsolved problem of the earth's history. There are various theories intended to explain the conditions, but none of them are quite convincing. The most reasonable one is, that countless years ago there must have been a sudden change of temperature at the poles from torrid to frigid. The animals were caught out of their latitude, frozen and buried in ice. A recent traveller in Siberia relates that happening to drive in a sledge along the base of one of the monstrous ice cliffs that overhang the estuary of the River Lena, he came upon a pack of wolves devouring the frozen flesh of a mammoth. The breaking away of a portion of the cliff had exposed the monster pile of preserved

meat, and at the hands of nature the wolves were helping themselves. So nature brings recompense for her freaks and takes care of her own. The meat mines of Siberia have not been developed, and no one knows what riches they may contain, or how they may yet be utilized in the economy of the world. The search may discover the delicacy of "filet de mammoth" warranted fresh from Siberia. —*London Jour. Applied Science.*

EDITORIAL NOTES.

At the December meeting of the Kansas City Academy of Science, Tuesday the 31st inst., a paper upon "Foot-prints of Primitive Thought" will be read by Judge E. P. West, after which there will be a discussion of certain questions proposed by Prof. Greenwood at the last meeting, viz:

1st. Is there any connection between the maxima and minima daily variations of the barometer and the magnetic needle?

2d. It is required to show by a simple mathematical process that the centrifugal force on the earth's surface decreases as the square of the cosine of latitude from the equator to either pole?

The record of the progress of science for the past month will be read by T. S. Case.

The Leavenworth Academy of Science, which is in a well organized and flourishing condition, held its regular monthly meeting on Friday evening, December 1st. A lecture upon the "Spectrum Analysis of the Heavenly bodies" was delivered by Mr. Coleman, which, according to the *Times*, was exceedingly interesting and instructive.

We have received, through the kindness of Captain Howgate, a number of *fac simile* drawings executed by Eskimo artists, living near Discovery Bay. These sketches represent different views of polar or arctic life, such as seal or walrus hunting, whaling and deer hunting, and show a fair degree of capacity for artistic culture by the natives. He also sent at the same time several copies of photographs taken by Prof. Sherman of the *Florence*, which give a perfect idea of the surroundings and native associates of her officers and crew during the past season.

The *Popular Science Monthly* for December contains an article by Prof. L. W. Peck upon the subject of explosions from combustible dust, in which he demonstrates that all combustible material when finely divided, forming a dust or powder, will, under proper conditions, burn with explosive rapidity.

The heaviest snow known for a number of years, for the season, fell in Southern Colorado last month. It was about five feet deep, and fell in less than twenty-four hours, causing much loss of stock and a great deal of suffering to travelers.

The most tremendous rains have lately been visiting some portions of Europe, and great damage has resulted from the floods.

The American Public Health Association, after a careful investigation of the yellow fever question in all its bearings, conclude that its transmission between points separated by any considerable distances, appears to be wholly due to human intercourse, and that a rigid quarantine, amounting to absolute non-intercourse, is the only really successful measure of prevention which has been adopted.

An electric hand lamp for domestic purposes has been invented in Philadelphia, which only weighs fourteen ounces, runs by self-contained clockwork, and is guaranteed to run for six hours, giving the light of *nineteen hundred candles*, at the cost of half a cent an hour. It will be placed on the market next spring at $6.

The *London Chemical News* publishes a note addressed by Prof. Norman Lockyer to the French Academy of Sciences, Oct. 28th, respecting the compound nature of the chemical elements, which is as follows, and seems to be the sole basis of the remarkable and sensational statements in the newspapers regard-the discovery:

"Reasoning from analogies furnished by the behavior of known compounds, I have discovered that, independently of calcium, many other bodies hitherto considered as elements, are also compound bodies," and remarks: "In communicating this note to the Academy of Sciences, at the meeting which was held on October 28th last, M. Dumas observed that it was the result of three years' assiduous research, in which Mr. Norman Lockyer. has, with the greatest care, compared the spectra of the chemical elements with the solar spectrum and other luminous celestial bodies. In the private letter to M. Dumas, accompanying his note to the Academy, Mr. Lockyer announces that he will shortly send the photographs and other details necessary, which will carry conviction to the minds of the members of the Academy."

Early last spring we sent a specimen of what was regarded here as a very rare fish to Prof. Spencer F. Baird, Secretary of the Smithsonian University, for identification. He pronounced it a Burbot, or *Lota Lacustris*. In the December 1st number of Cassino's *Science News*, we find an engraving of the *Lota*. and a careful description by Dr. Bean, who says that it may be recognized by its resemblance to the eel, and that among its poplar names are those of eel pout, and chub-eel, and mother of eels. He also says that the specimen from Kansas City represents the most southern of any in the National Museum collection, and asks that specimens be sent to Professor Baird, from all localities, except the Great lakes and those of Western New York, with all possible information relative to their habits of life, diet, appearance of the young, &c.

A bronze statue of Humboldt was unveiled with appropriate ceremonies on the 24th inst. in Tower Grove Park, in St. Louis. It is the gift of Mr. Henry Shaw, a prominent naturalist of the city, who has for many years devoted himself to science and art, and to whom St. Louis in indebted for many liberal deeds.

Professor Fitzpatrick, Superintendent of the Leavenworth Public Schools, in his monthly report to the Board of Education, advocates the half-time plan for all the lower grade scholars, and adduces the example of Providence, Cleveland, Detroit, Boston, Chicago, Kansas City, &c., in its favor. This system is fully established in the schools of Denmark, Switzerland, and England, and gives better results all around than the old plan of full day sessions for all scholars alike. In Lawrence it has been adopted for all grades in all the public schools.

W. J. McGee, in an essay read before the American Association for the Advancement of Science, claims that the most trustworthy means of distinguishing between the crania of Mound Builders and those of modern Indians, is the greater relative size of the posterior molars, or the "wisdom teeth," in both jaws of the former than in those of the latter. Also by the degree of development of these teeth in young subjects, it having been much earlier in the Mound Builder than in the later man.

We are indebted to the *Phrenological Journal* of New York, for the electrotype of Prof. Newcomb which illustrates this number. This journal is the leading one of its class in this country, if not in the world, and its publishers are always courteous and obliging to the fraternity.

Prof. T. J Eaton furnishes the following analysis of Kansas river water from the hydrant near his drug store:

	Grains.
Total Solids per Am. gal	29.769
Residue after Incineration	28.030
Dissipated by heat	1.739
Silicic Oxide.	.002
Calcic Carbonate	13.202
Magnesic Sulphate	3.100
Sodic and Potassic Carbonate. . . .	3.189
Aluminic Sulphate	1.895
Sodic Chloride	6.132
Iron trace, Potas. Sulphate trace, Loss	.510

This is, compared with the drinking water of other cities, quite pure, and far within the limit of "potable waters," which is about 50 grains of saline constituents to the gallon. The amount of organic matter, a little more than a grain and one half to the gallon, is far less than is generally believed.

On the 7th inst., Prof. Arthur Lakes, of the Colorado School of Mines, dropped in and made us a brief visit. He was on his way to New Haven to assist Prof. Marsh in classifying and arranging the fossil remains of various saurians exhumed by him last season, and sent to the cabinet of Yale college. He will be absent about six months and in the mean time will favor the readers of the Review with an occasional descriptive article.

Dr. Van Eman, having been appointed by the Medical Society of this Congressional district to examine into and report upon the general condition of our public schools, made to that body, on the 5th inst., a full statement of the attendance, ages and classification of scholars; sanitary condition of the school rooms and out-buildings, including seating, ventilation, heat, light, water, and time occupied daily in study. On the whole the report is very flattering to the management of the schools; the only fault found being with the lack of room for so many pupils, which can not be avoided by the Board, the height of the seats in the lower grade rooms, which can easily be remedied and which should be attended to at once; the deficient supply of fresh air in some of the rooms, based on measurement, which is in some respects an unreliable test, and the quality of the drinking water, which is supposably that of the Kansas river, as an analysis of that water by Prof. Eaton (quoted in another place) is given at the conclusion of the report. Our own judgment is that the cistern water, which is, in fact, used at most of our schools as well as the homes of the children, contaminated as it is by the coal smoke, dust and foul atmosphere of the city, filled with effete organic matters, is far more baneful to the consumer than Kaw water with the constituents found in it by Dr. Eaton.

Rev. Noah Porter, D. D., Prest. of Yale College, prepared and had read before the Victoria Institute, in London, in the latter part of November, a paper entitled "On Science and Man, with Special Reference to Prof. Tyndall's Late Address." It is an admirable reply to Prof. Tyndall, and we will present it to our readers next month entire.

Just as we close this number, (December 13th,) the heaviest snow storm remembered in this locality, is upon us, already the depth of the snow is believed to be fully 18 inches on a level, though it is so badly drifted as to almost defy measurement, and the fall continues.

We learn from the Junction City *Union* that an ancient mound, about six miles from the city, was explored on the 28th of November and a quantity of human and other bones and some small fragments of pottery exhumed. This, taken in connection with the mounds near Ft. Leavenworth, shows that the belief which has hitherto generally prevailed, that no traces of the Mound-Builders exist west of the Mississippi river, is erroneous; and it is probable that as the subject is more thoroughly investigated, it will be found that a line of mounds exists all the way to the Gulf, as in the middle States. We shall publish the article in full in our next issue.

The *Supplement* to the *Popular Science Monthly* will be discontinued henceforth and the *Monthly* itself increased in size, to make up for it, without increase of price.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. II. JANUARY, 1879. NO. 10.

GEOGRAPHY.

CONGRESS AND THE NORTH POLE.

AN ABSTRACT OF ARCTIC LEGISLATION IN THE CONGRESS OF THE UNITED STATES.

BY CAPT. H. W. HOWGATE, U. S. A.

IV.

THE POLARIS EXPEDITION.

HOUSE OF REPRESENTATIVES, March 8, 1870.

The Hon. J. E. Stevenson, of Ohio, introduced a joint resolution (H. R., No. 187), relative to a voyage to the Arctic regions, which was read a first and second time, referred to the Committee on Appropriations, and ordered to be printed.

IN SENATE, March 25, 1870.

Mr. Sherman, of Ohio, introduced a similar resolution, (S. R., No. 166,) which was read twice by its title, referred to the Committee on Foreign Relations and ordered to be printed.

April 19, 1870.

Mr. Sumner reported the resolution with an amendment.

May 2, 1870.

The Committee on Foreign Relations reported the joint resolution with an amendment, which was to strike out the preamble, and all of the original resolution in the following words:

Whereas, Capt. C. F. Hall is an enterprising and experienced explorer, who has made two successful voyages in the Arctic regions, and

Whereas, he desires, in the interests of science and for the material advantages of his country, to make a voyage of exploration and discovery under the authority and for the benefit of the United States, therefore

"*Be it Resolved*, That the President be and he is hereby authorized to furnish a naval or other steamer, and if necessary, a tender for a voyage into the Arctic regions under the control of Capt. C. F. Hall.

Section 2. And be it further

Resolved, That the sum of one hundred thousand dollars be, and the same is hereby appropriated out of any funds in the Treasury, not otherwise appropriated by law, which sum, or so much thereof as may be requisite, shall be paid out on the order and expended under the direction of the President in proper and necessary expenses of said voyage.

And to insert in lieu thereof:

Be it Resolved, That the President of the United States be authorized to organize and send out one or more expeditions for Arctic explorations toward the North Pole, and to appoint such person or persons as he may deem most fitted to the command thereof; to detail any officer of the public service to take part in the same, and to use any public vessel that may be suitable for the purpose; the scientific operations of the expeditions to be prescribed in accordance with the advice of the National Academy of Sciences, and that a sum of one hundred thousand dollars, or such part thereof as may be necessary, be hereby appropriated out of any moneys in the Treasury not otherwise appropriated, to be expended under the direction of the President.

Objection being made to its present consideration, the joint resolution was passed over. * * * * * *

May 23, 1870.

Mr. Sumner offered the amended resolution as an amendment to the legislative, executive and judicial appropriation bill, and said that he had no desire to debate the proposition.

Mr. Williams, (Oregon). "I think we had better vote it down."

The question being put, it was decided that the amendment appeared to be rejected; and a division was called for.

Mr. Sumner. "As there is to be a division, I desire to explain to the Senate the origin of this amendment. It will be remembered that the Senator from Ohio, the Chairman of the Committee on Finance, as long ago as March 25th, introduced a joint resolution relative to a voyage to the Arctic regions, which, on his motion was referred to the Committee on Foreign Relations. The Committee took this resolution into careful consideration; they were occupied upon it at

several meetings; they heard witnesses. Among others they listened for a long time to Capt. Hall, and also to Dr. Hayes, of New York, both of them eminent Arctic explorers.

The conclusion that the Committee came to was, that it would be in the interest of science and for the dignity of this Republic that it should countenance such an expedition, but on the evidence before it the Committee hesitated to choose between these two explorers.

They were unwilling to hold the scales. They had before them strong testimony in favor of each. For instance, I have here a file of papers, all of which I will not read. One, for instance, is a letter from the eminent head of the Coast Survey, Mr. Pierce; it is short and I'll read it:

CAMBRIDGE, MASS., April 9, 1870.

MY DEAR SIR:—I cannot understand how giving to Capt. Hall takes away from Hayes. As to myself, I think the cry of North Pole is one of those popular notions through which much good is done to the service of knowledge. The strong letter of Prof. Henry, is to me sufficient justification for the support of Capt. Hall, and it seems to me that he is well fitted to do good work, and tha the attack on him is an unprovoked outrage. That he has defects, and especially in scientific culture is obvious enough. But he is modest and acknowledges his own defects, at the same time that he makes claims which seem to me in my poor judgment, as not unworthy of regard. I am not aware that any expedition has yet returned from the Polar regions without bringing back its money's worth in increase of knowledge, and Capt. Hall's plans seem to give good promise of just as valuable returns. But I would also be glad to see Dr. Hayes, or anybody else, embarked in enterprizes of their own.

The Polar regions are wide enough for many explorers, and no harm would come from a little rivalry. Let them both go; the cost is nothing for such a nation as our own.

Yours very truly,

BENJ. PIERCE.

That letter I may say, is the voice of science itself. Prof. Pierce is known, not only in our own country, but abroad, as one of the most eminent and accomplished scientific characters that our country has ever produced, and here you have his testimony.

Then comes a series of resolutions presented to the Senate by the Senator from New York, (Mr. Conkling.) adopted by the Geographical Society, April 11th, 1870, as follows:

ROOMS OF THE GEOGRAPHICAL SOCIETY, N. Y., April 11, 1870.

The following resolutions are recommended by the Council, and were unanimously adopted at the regular monthly meeting of the Society.

Resolved, That it is eminently desirable that an expedition should be fitted out by the Government, for Arctic exploration and the discovery of the North Pole.

Resolved, That in view of the great perils and difficulties which attend any attempt to penetrate the Arctic regions in vicinity of the Pole, and as the objects

to be attained are scientific, the expedition should be commanded by a Naval Officer of Arctic experience, having under him an efficient scientific corps, so that an amount of scientific information may at least be gathered, as will reflect honor upon the country, and justify the fitting out of the expedition.

Resolved, That, without assuming to dictate to whom the command of it should be intrusted, we would call attention to the fact that Dr. Hayes has received the gold medals of the Royal Geographical Society of London; the Imperial Geographical Society of Paris; the endorsements of the Imperial Societies of St. Petersburg; the Geographical Society of Berlin; the Royal Academy of Sciences of Brussels, and the Geographical Society of Italy, and having in his last expedition, though provided with very insufficient means, reached nearer to the Pole than any previous explorer, except Parry, he is, in the opinion of this Society, to be regarded as the most able, eminent and experienced of living American Arctic explorers.

Resolved, That copies of these resolutions be forwarded to both Houses of Congress.

Thus, sir, the Committee had before them testimony in favor of these two distinguished explorers. Hesitating to decide between them; not willing to take that responsibility, but at the same time uniting in the conclusion, and I think they were unanimous, that such an expedition should be attempted; that it belonged to the United States, in the interest of commerce, as a representative of science, for the sake of humanity, for the advancement of knowledge, to see that such an expedition should be attempted, they directed me to report a bill as a substitute for that which had been referred to the Committee on the motion of the Senator from Ohio. At a subsequent day, following again the instruction of the Committee, I gave notice of the motion which I have now made, to move that bill as an amendment to this appropriation bill. Such, sir, is the brief history of this proposition, and how it comes before the Senate at this time, and the simple question is, whether you will hesitate in this work.

Already the great powers of Europe, one by one, have attempted this discovery. England, Germany, Denmark, and we are now told that France is planning an expedition.

Shall the Great Republic alone stand aloof? Shall we, who have a greater interest in this discovery, and in the extension of a knowledge of this hemisphere than any other power, shall we be the only one that shall not participate in the work? Mr. President, I am not disposed to enlarge this topic; Senators will all understand it without further explanation. The amendment is simple. It refers the whole matter to the President of the United States, empowering him, in his discretion, to equip one or more expeditions. I think the work ought to be done and I hope the Senate will now unite in it."

The question being put there were, on a division—Ayes 21, Nays 16.

Senators McCreery (Ky.), and Trumbull (Ill.), called for the yeas and nays, which were ordered, and resulted—yeas 25, nays 25.

The Vice-President, Mr. Colfax, voted in the affirmative, and the amendment was agreed to.

HOUSE OF REPRESENTATIVES, July 9, 1870.

The Senate amendment was agreed to by the Conference Committee, substituting the sum of fifty thousand dollars for the amount originally proposed by the Senate.

The act was approved by the President, July 12th, 1870, and on July 20th, Capt. Hall was designated as the Commander of the expedition.

The U. S. Steamer, "Periwinkle," 387 tons, was selected for the expedition and re-christened the "Polaris" by Capt. Hall. She sailed from Washington June 10th, 1871, and from New London July 3d, 1871. The history of the expedition is too fresh in the memory of the American public to justify repetition here. It is only necessary to state, that after the death of Capt. Hall, no determined effort was made to get north of the winter quarters selected by him, and that on attempting to return home the "Polaris" was caught in the ice and sunk off Littleton Island, Oct. 15th, 1872. Part of her crew were picked up April 30th, 1873, in Lat. 53° 35′ N., off Grady Harbor, Labrador, by the bark Tigress of Newfoundland, after drifting upon an ice-floe from the date of the disaster. The remainder, after wintering on Littleton Island, were picked up by the steamer "Ravenscraig," of Dundee, Scotland, June 23d 1873. in Lat. 75° 38′ N., Long. 65° 35′ W.

The Sundry Civil appropriation bill for the fiscal year ending June 30th 1875, contains the following clause, providing a suitable recompense for the parties affording relief to the shipwrecked explorers.

* * * * * * *

"The Secretary is hereby authorized and directed to make, out of any money at his disposal available for that purpose, sufficient and appropriate compensation and acknowledgment to the owners, officers and sailors of the British whaling and sealing steamers which contributed to the rescue of the survivors of the "Polaris," for such rescue, and any loss sustained by reason thereof, and for their humane and hospitable reception, entertainment and transportation until they were all finally and safely landed in Newfoundland and Scotland."

* * * * * * *

In the Deficiency Appropriation bill for the year ending June 30th, 1875, the following passage occurs:

* * * * * * *

"For printing illustrations of the results of the Polaris expedition, under the direction of the Secretary of the Navy, fifteen thousand dollars."

* * * * * * *

An act for the relief of the survivors of the "Polaris" was passed March 3d, 1875. as follows:

Be it Enacted, &c., That the proper accounting officers of the Treasury be authorized and directed to pay, out of any money in the Treasury not otherwise appropriated, to the survivors of the "Polaris," engaged in the Arctic exploration under command of Capt. Charles F. Hall, their widows, or minor children, and in the order named, a sum of money in addition to that already paid, equal in amount to one year's pay which each would have been entitled to respectively

if continued in the service, under the rules and regulations prescribed by the Secretary of the Navy for said exploring expedition; and that the sum of three hundred and sixty dollars each, be paid to Joe Eberling and Hans Hendrick, Esquimaux, who rendered valuable assistance to that part of the ship's crew rescued from the ice-floe, on or about the 30th day of April, 1873; said payment to be made direct to each individual claimant, upon satisfactory evidence of his identity,

Provided, That if any sale, assignment, or transfer shall be made of any interest in the gratuity provided by this act, the amount so assigned shall revert to the Government of the United States.

The narrative of the Polaris expedition proved such an interesting work, that a new edition was authorized by Act of Congress, June 14th, 1878, in the following words:

June 14, 1878.

Be it Enacted, &c., That the Public Printer be, and he is hereby authorized to print from the stereotyped plates, now in his possession, such number of copies of the Narrative of the Polaris' expedition as may be subscribed and paid for within such reasonable time as the Public Printer may designate,

Provided, That the whole number printed shall be sold at the cost of publication with ten per centum additional, and no greater number shall be printed than shall have been subscribed and paid for prior to going to press thereon, and authority is hereby given to the Public Printer, to procure the material, engravings and lithographs necessary for the publication of the work, and it shall be the duty of the Public Printer to cover all moneys received for copies of the works into the Treasury, making a report thereof in his next annual report.

V.

THE BENNETT POLAR EXPEDITION.

Mr. James Gordon Bennett, of the New York *Herald*, having bought the well known Arctic steam yacht "Pandora," for the purpose of making an attempt to reach the Pole *via* Behring's Strait, was desirous of having her sail under the American flag, and the command of an officer of the U. S. Navy. The necessary legislation for this purpose was procured by the passage of the following Act of Congress, which was approved by the President, March 18th, 1878.

"WHEREAS, James Gordon Bennett, a citizen of the United States, has purchased in Great Britain a vessel, supposed to be specially adapted to Arctic expeditions, and proposes, at his own cost, to fit out and man said vessel, and to devote her to efforts to solve the Polar problem; and

WHEREAS, it is deemed desirable that said vessel, while so engaged, shall carry the American flag and be officered by American Naval Officers, therefore

Be it Enacted, &c., That the Secretary of the Treasury be authorized to issue an American register to said vessel by the name of "Jeannette," and that the Presi-

dent of the United States be authorized to detail, with their own consent, commissioned, warrant, and petty officers of the Navy, not to exceed ten in number, to act as officers of said vessel during her first voyage to the Arctic seas,

Provided, However, That such detail shall be made of such officers only as the President is satisfied can be absent from their regular duties, without detriment to the public service.

The "Jeannette" is announced to sail in the early part of 1879, from San Francisco, under command of Lieut. Geo. W. DeLong U. S. N., a young officer of marked ability and enterprise, and who has had some experience in Arctic work along the Greenland coast, in searching for the Polaris' survivors in 1873.

Past efforts to attain high latitudes *via* the Behring's Strait route have not been sufficiently successful to warrant very sanguine hopes of future success by that route, but the "Jeannette" will be followed by the best wishes of the friends of Arctic exploration in Europe and America, and if she fails in accomplishing all that is desired in the solution of the Polar problem, it may be safely assumed that it will not be from any lack of effort or energy on the part of her owner or of her commander.

VI.

POLAR COLONIZATION.

Although not properly coming under the head of actual legislation, the Congressional action upon the Colonization question has been of a sufficiently positive nature to justify a brief reference to it in these pages.

CONGRESSIONAL ACTION.

The first formal action taken in Congress, in reference to the measure, was the introduction of the following bill, which was offered in the House of Representatives on January 8th, 1877, by Hon. Morton C. Hunter, of Indiana:

A bill to authorize and equip an expedition to the Arctic seas.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States be authorized to organize and send out one or more expeditions toward the North Pole, and to establish a temporary colony, for purposes of exploration, at some point north of the eighty-first degree of north latitude, on or near the shore of Lady Franklin Bay; to detail such officers or other persons of the public service to take part in the same as may be necessary, and to use any public vessel that may be suitable for the purpose; the scientific operations of the expedition to be prosecuted in accordance with the advice of the National Academy of Science; and that the sum of fifty thousand dollars, or such part thereof as may be necessary, be hereby appropriated out of any moneys in the Treasury not otherwise appropriated, to be expended under the direction of the President:

Provided, That no part of the sum so appropriated shall be carried to the surplus fund or covered into the Treasury until the purpose of the appropriation

shall have been completed, but may be applied to expenses of said expedition incurred during any subsequent year that said expedition may be engaged in its duties.

After a second reading the bill was referred to the Committee on Naval Affairs and ordered to be printed. On February 9th, 1877, it was introduced in the Senate by Hon. Henry L. Dawes, of Massachusetts, read twice and referred to the Committee on Naval Affairs. On February 22, of the same year, it was reported favorably from the House Committee on Naval Affairs by Hon. Benjamin A. Willis, of N.Y., and recommitted. No further action was taken on the bill bythe 44th Congress, but soon after the meeting of the 45th Congress it was again introduced in both Houses by the same members and in each referred to the Naval Committee. On the 22d of January, 1878, Mr. Willis, on behalf of the Naval Committee of the House, submitted a favorable report.

On the 13th of February, 1878, Hon. A. A Sargent, from the Naval Committee of the Senate submitted as the report of that Committee the House Committee's report, concurring in its conclusions and recommending the passage of the bill.

On the 18th of June, 1878, an effort was made to obtain action on the bill, Mr. Danford, of Ohio, moving in the House to suspend the rules and pass it. The bill was read and the question being put there were, ayes, 65, noes 56. So (two-thirds not voting in favor thereof) the rules were not suspended, and the bill went over to the present session, during which it is hoped that favorable action will be taken in compliance with what is believed to be the wishes of the commercial, as well as the scientific interests of the country. The Chambers of Commerce and Boards of Trade of nearly every large city in the United States, have requested their Representatives in Congress to favor the bill, and hasten its passage, while scientific associations have urged the same request with gratifying unanimity.

PHYSICS.

THOUGHTS ON OUR CONCEPTIONS OF PHYSICAL LAW.*

BY PROF. FRANCIS E. NIPHER, ST. LOUIS, MO.

In the short time at my disposal, I wish to point out some reasons for the more general cultivation of a certain cardinal virtue which is so rare that I fear it has no name. Perhaps the words, *Intellectual Modesty*, would come as near as any others in expressing what I mean. The world is very full of people who are ready to make assertions upon subjects which are evidently too difficult for them —in many cases too difficult for any one—to handle with any degree of certainty; and it doubtless often happens that some who have meditated studiously

*An adderss before the Alumni of the State University of Iowa, June 19th, 1878; delivered at Kansas City, December 23d, 1878.

for years upon some such subject, arriving at no satisfactory conclusion, are regarded as objects of profound commiseration by others, who rush upon conclusions like the unthinking horse into the battle. It is as natural that people should thus differ, as that some should have darker skins, taller frames, or more irritable tempers than others. To what extent these, and other differences which we shall point out, are blameworthy, we cannot attempt to discuss, but shall study the mental habits of men in precisely the same spirit in which we would study the habits of other animals. But I wish to show some tangible reasons for thinking that there are very few subjects upon which we can dogmatize, and that in any case it is unnecessary. I wish to advocate the cultivation of intellectual modesty, not merely because it seems to me to be one of the brightest ornaments of the human mind, but because of its vital connection with another cardinal virtue—intellectual honesty.

Perhaps this end will be best attained by considering the difficulties which are met in the investigation of any subject, when the sole aim is to find out the truth of the matter, and I have thought it proper to point out some of the difficulties to which we are subject in arriving at our conceptions of physical law.

The study of physical science has endowed the human mind with an attribute which is usually ascribed to and is thought to be characteristic of the Divine Mind. I refer to the power of prophecy. The astronomer can predict the position of the planets for generations to come, basing his predictions on the assumption—an unproved assumption—that only those causes which he has considered will act in the future, or, in other words, that the present order of things will continue. His power of prediction does not, however, extend indefinitely into the future, for there are, doubtless, many minor disturbances or perturbations, too small to be detected by the instruments which he can command, without many centuries of observation, the effects of which will become plainly apparent after the lapse of ages—that is to say, his power of prophecy is limited by his ignorance of certain facts, and, possibly, by his inability to solve the equations involved in a complete discussion of the subject.

It is for precisely the same reason that *we* cannot foretell the future destiny of every person in the world. But to a mind possessing all knowledge, and of infinite power, the one problem would evidently be as simple as the other.

We can readily imagine a being, possessing sufficient knowledge and ability, to calculate the orbits of every person now living. Such a being must know all that is to be known in regard to our mental and physical organisms, and the circumstances under which we are and will be placed. Having thus the initial stage and being able to trace succeeding events as logical sequences of the present, *such a being could predict exactly what each of us will decide to do, under the present and all succeeding circumstances—could predict how far we will be physically and mentally able to carry our resolutions into effect.*

But how awful must be the mind which could perform such a task! The most gifted mathematicians, have, after enormous labor for two centuries, given an approximate solution of the interaction of three gravitating bodies, but they

tell us that the methods used would not apply to four bodies, each of which exerted appreciable effects upon the others. How utterly beyond human power it would be to discuss the motions of the millions of chemical atoms contained in a single ounce of matter. Herschel has said that each of these particles is forever solving differential equations, which, if written out, might belt the earth.

But our imagined ideal mind must deal with the physics of our globe, and the interaction of its myriads of men. The whole phenomena of meteorology must be calculated, not only for every part of the earth, but for all time. The effect of these climatic influences upon each man, and upon the grain or other productions of his industry, must be determined. The repressing effects of political and social tyranny, and the conditions of their existence; the refreshing effects of food and sleep, and the circumstances which may sometimes prevent communities or individuals from obtaining enough of them; the moral influence of men upon each other—to come to smaller matters, the effect of the present address upon each member of the present audience—all must be taken into account in this stupendous calculation. And now, given the myriads of vibrating atoms, and whatever else may constitute a man, and the external forces which act upon him, the manner in which the atomic motions of his body will be modified, and the resulting effect upon his thoughts and decisions must be determined. The calculation must be comprehensive enough to include the thoughts and actions of all men through all time. Such a being would be able to determine, by aid of some high order of mathematical analysis, how many men will exist upon this earth five hundred years hence, would be able to locate each man, as astronomers predict the position of planets, and must be able to predict what task will then employ his hands, what train of thought will then be passing through his mind. A great famine occurs in China: it is produced by a combination of unfortunate circumstances, and the exact limit of its ravages could have been predicted, ages before.

A certain closed line drawn upon the earth, would mark out the area where 25 per cent. of the inhabitants would starve to death. Outside of this area would lie a belt of country, where 20 per cent. would die, and in this manner the whole of the melancholy facts could be represented. The discussion of the distribution of people and food, the means of transportation, the physical strength and wealth of individuals affected, and other matters involved in the question, would enable an all-powerful mind to determine to what extent each individual would be affected and which ones would be strained beyond physical endurance. The position of each atom of matter in our world must be deducible, and the exact manner in which each atom moves and vibrates. Some portion of matter may repose for ages, locked in some rocky ledge. Infinite intelligence can calculate when a chance stroke from a workman's hammer may beat it loose, at what time it will be borne aloft on the fickle and inconstant winds, and when and where it will again fall, now it becomes part of some animal or plant, but everywhere its existence is recognized and its path is traced by infinite mental power.

When we consider that our earth is but a speck in this universe of universes, that untold millions of suns and worlds are scattered through space, and that all

are grasped by a knowledge equally profound, we begin to get some faint idea of the magnitude of that mind which can solve the general equations of the universe, and we can begin to realize, how comparatively insignificant, how necessarily imperfect, are our highest mental achievements.

Whether or not there be such a being as the one we have here imagined, it would be foreign to our purpose to discuss, but it seems to me that very few who talk fluently on either side of the question, have ever tried to weigh, in a calm and dispassionate manner, the awful import of the words they use.

In such a calculation as the one we have here supposed, mental philosophy would become an exact science. The intensity of mental action, the strength of different minds, and quantities of pleasure and pain would be determined. The logic of the wise and the foolish, the learned and the ignorant, the virtuous and the vicious, would be followed out to the conclusions which these minds would severally reach, under the particular circumstances in which each is placed.

Let us assume that one of the secret springs of human action is this: that in any given case we decide to do that which we then think will give us, on the whole, most pleasure or least pain, often deciding, however, to give up a greater pleasure, to be enjoyed only in the future, for a lesser one which we can enjoy immediately, precisely as we sometimes allow a note to be discounted in order that we may realize upon it at once; or, to take another case: we have in mechanics a principle known as the "principle of least action." Applied to the solar system, it affirms that each of the planetary bodies so moves, that the sum of the energy lost by counter attraction, is less than if they moved in any other way. If this law holds in the interaction of men in society, it would mean, that however erratic the orbits of individual men may be, however much trouble may come upon them, or however much they may bring upon themselves, taking men as they *are*, the sum of human trouble is less than if men *did* differently, *being* what they are. Assuming that man is wisely constructed, mentally and physically, this is merely saying, in other words, that the present order of things is a wise one.

We are hardly in a position to assert that either of these statements is really a law of social physics. They are referred to here merely to indicate the nature of the results, which could be reached by mathematical analysis if we were able to discuss the interaction of moral and mental centers of action as astronomers discuss, approximately, the interaction of worlds.

Not only are we unable to predict for an infinite future, on account of the summing up of disturbances which cannot be detected in a short time, with our means of investigation, but, as before suggested, events wholly unexpected to our partially instructed minds—apparent breaches of continuity—are liable to happen at any time. A tribe of savages, not acquainted with fire-arms, may acquire a loaded musket. In toying with it for a time they become familiar with its appearance, and, as they think, with its properties. But some day they succeed in discharging it, an event which they are powerless to bring about again by an exact repetition of the act which brought it about before. Who shall say that there are not hair triggers in the universe, upon which we may sometime stumble? *"We

* See Jevon's Principles of Science, 1877. pp. 742-748.

can imagine intelligent beings living on a world surrounded by an atmosphere of oxygen and hydrogen. So long as they were unacquainted with fire, they might live for ages in fancied security," studying the laws of the evolution of their world, and making wise predictions in regard to its future. But the production of a single spark of fire would ignite their atmosphere, and wrap them in utter destruction. "We know not at what moment immense, and to us, wholly unexpected energies may be called into action. For all that our knowledge can tell, the volume of human history may be finished during the next hour. A great explosion on the sun may scorch us into cinders in a second. The earth may be dashed to pieces and dissipated into gas, by collision with some immense meteorite. We may become involved in a nebulous atmosphere of combustible gas, which would ignite a moment later; in fact, as was so eloquently pointed out by Mr. Babbage, there is no catastrophe too great, or too sudden, to be consistent with the reign of law, and the continuity of action."

In the discussion of physical phenomena, we always ignore the greater part of the discussion, by neglecting those elements which are, or are supposed to be, unimportant. In so simple an operation as the weighing of a quantity of matter on a steelyard, we can discuss only the merest elements of the case. The student of Physics would tell you, that the weights are inversely as the lever arms, but this is far from being the whole story. During the weighing, certain parts of the steel bar are heated; other parts are cooled; still other parts retain their temperature unchanged; electrical currents are set up within its mass; its magnetism is changed; its torsion and elasticity become different—in fact, to discuss all the changes occurring within the bar during so simple an operation, would infinitely transcend the power of the most gifted men.

If we could discuss completely the laws which govern phenomena, we should find them represented, in many cases, not by the comparatively simple formulæ, which have been found sufficient for practical purposes, but by infinite series, the first terms only of which our mathematicians have been able to deduce, and our physicists to experimentally detect.

What is here said of physical problems, is also true of problems of pure mathematics. It is stated by mathematicians, "that those problems which have been solved, are but an infinitely small part of those which can be proposed, that they are all special cases, (although sometimes called general) and that if a problem were selected, at random, out of the whole number that might be proposed, the probability would be infinitely slight—that any human being could solve it."

Even those problems that have been satisfactorily solved, involve ideas that we cannot comprehend. Let us take a simple problem in Geometry. Imagine two wooden rods, or finite lines intersecting each other, and let us revolve one of them until they become parallel. Consider these lines infinitely prolonged, and let us see what becomes of these prolongations. As one line is revolved the point of intersection travels outwards. Finally the lines might seem to be parallel, but perhaps if we were to travel along the lines for a million of miles, we might come to the point of intersection. The mathematicians say, that when the lines

have become parallel, the point of intersection will be removed to an infinite distance, which is, they say, equivalent to saying that the lines will not intersect. Where in space will these lines part company? Have they ends, which the point of intersection finally reaches, and which then separate from each other? No! The lines are supposed to be without end. *However far* the point of intersection may have travelled, we may straightway regard this distance, as represented by the first term of a divergent series of an infinite number of terms, each term of which is infinitely greater than the one which preceded it. We can form an independent conception of two infinite and absolutely parallel lines, but we cannot imagine how the infinite prolongations of intersecting lines can ever separate; nevertheless, we can continue the rotation of our finite line, until it passes through parallelism, and the point or at least a point of intersection comes travelling towards us from the opposite direction.

Prof. Jevons appears to think that our difficulty in such cases, is due to an imperfect idea of infinite space.*

In the study of Physics, our most certain experimental results force us to ideas equally beyond our power of realization. It is shown beyond question, that light moves over a distance of about seven times the circumference of our earth in a single second. We must look for something marvelous in any theory which can account for so marvelous a fact. According to Newton's theory, we should have particles of light, shooting off from a distant luminous body with this immense velocity, and, falling upon a mirror, their motion would not merely be checked, but the elasticity of these light particles must be assumed to be so perfect, that they rebound with an equal velocity.

According to the undulatory theory, the light consists of vibrations of a medium which fills all space. Since the velocity of transmission of these vibrations is so great, it follows that the elasticity of this medium must be 10,000,000,000 times as great as that of the hardest steel. Space is not now regarded as a void, but as filled with a medium which, as Thomas Young remarked, "is not only highly elastic, but absolutely solid." And yet, as we walk through space, the solid atoms which compose our bodies, experience not the slightest resistance. Such ideas, although they can be conceived, cannot be realized. We have had no previous experience with materials possessing such properties, and such ideas must necessarily appear strange to us; but they are no more strange than the phenomena of light which we directly observe, and which force us to this, or to some other theory, equally marvelous. Only those who have carefully examined the subject, can realize how weighty is the evidence in favor of the undulatory theory of light; but where such stupenduous conceptions are involved, a slavish acceptance of any theory, even by them, would be in the highest degree objectionable. We are not the friends of theories, but of truth.

So in all departments of thought, we come sooner or later to depths which the human sounding line cannot pierce; we reach ideas, about which it becomes hazardous to talk, unless one courts the position of a babbler of nonsense; we

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* **Principles of Science, p. 767.**

learn that all our "final" formulæ contain unknown quantities. As we are not infallible, we must therefore be cautious and modest.

It is not surprising then, that in the progress of our sciences, many errors of reasoning and in the interpretation of facts have been committed. You are all familiar with the ideas of Newton, in regard to the nature of light, ideas which were not in themselves absurd, which were firmly believed in by this man of such transcendent power, but which were clearly negatived by results of subsequent experiment.

It was known long ago, that rain-gauges placed above the surface of the ground, caught less rain than those placed at the surface, and it is still taught in many of our text-books, that this is due to a condensation of moisture in the lower strata of the atmosphere. This idea is not absurd, but it has been shown* that this cause produces no appreciable effect, and that the observed effect is due to the action of the wind, "which sweeps some rain out of all gauges, and most, out of those which are highest, and therefore most exposed."

Lavoisier's idea that all acids were compounds of oxygen, received a complete refutation when the constitution of prussic and muriatic acids became known. In fact, the errors of scientific men are well nigh innumerable, not because they are men of science, but because they are *men*, and we are probably justified in saying quite in general, that if the man who never committed a mental blunder be found, we shall also find a man who never conceived a vigorous thought. The fact that the results of scientific men can usually be checked by observation and experiment, perhaps diminishes their liability to err and enables them to discover multitudes of errors that would otherwise escape their attention. This does not tend to make the results of their investigations less weighty than results which have been reached by other processes, more purely mental. If men of science, with their severe methods of research, their habits of testing their conclusions by observation and experiment, are nevertheless led into wrong conclusions, what does it prove? Simply that the human mind, even under the most favorable circumstances, is fallible! Is there a class of men less liable to make mistakes? It is precisely this experience which causes many to place a small value upon the unsupported assertions and speculations of any man, however honest, earnest, or able he may be.

On this point, one of the most admirable of experimenters, Faraday, has beautifully said: "The world little knows how many of the thoughts and theories which have passed through the mind of the scientific investigator, have been crushed in silence and secrecy by his own severe criticism and adverse examination; that in the most successful instances, not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions, have been realized."

In the 24th series of his "Experimental Researches," Faraday describes many tedious and intricate experiments, in which he tried to connect gravitation and electricity. "He labored with characteristic energy for days, on the clock tower of the Houses of Parliament and in the shot-tower of Southwark, raising

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* Jevons, in Phil. Mag. Dec. 1861.

and lowering heavy weights, connected with wire coils. Many times his great skill as an experimenter prevented him from being deceived by results which others would have regarded as conclusive proofs of his idea, and when the whole was done, there remained absolutely no result." For although the results were wholly negative, Faraday could never accept them as conclusive against his idea, to which he had been led by his experiments on the relations between electricity and magnetism. His mental condition after this work was done, is best described in his own words. "Occasionally, and frequently, the exercise of the judgment ought to end in *absolute reservation*. It may be very distasteful, and great fatigue to suspend a conclusion; but as we are not infallible, so we ought to be cautious."

It is a matter of common observation, that men who, like Faraday, have done much to widen the boundaries of our knowledge, are precisely the ones who are most frequently in a state of doubt, while those who have received all their knowledge at second hand are generally more ready with a positive decision and a reason for it, not necessarily because their intellectual integrity is less, but because they *cannot* realize how vain a thing the human reason is. To imagination and reason, controlled and checked by experiment and observation, are we to look as the source of the greatest advancement in science; but we are not to look for infallibility, and in cases where the reason alone is allowed to decide, where observation and experiment are impossible, the uncertainty must necessarily be greater. In many cases the fact that the subject is so intrinsically difficult that no experimental check is possible, appears to inspire the investigator with a confidence in his conclusions, that could hardly be reinforced by absolute certainty.

But we have not yet exhausted the list of errors to which scientific men are liable, in arriving at what we provisionally call correct conceptions of physical law. A few of them have carried their investigations into a domain in which certain hypothetical beings called "spirits" are said to be the main actors. It is exceedingly probable that a few trained investigators have been deceived in regard to the evidence of their own senses. This is not an unlooked for result, as it can be readily reproduced in the performances of any expert juggler.

I have confined myself to the errors which scientific men have committed, and to which they are liable in their search for truth, not because they alone are liable to err, but because a discussion of the multitude of errors into which intellectual men of other professions have fallen, would be sure to give offense. But it is not the scientific mind which stands impeached—it is the *human* mind!

To what end have we then come? It appears that all scientific results are attended with some uncertainty. Sometimes the uncertainty is very small, and we are able to obtain a numerical estimate of it. In other cases it may be possible that a fundamental misconception of the truth may have been formed. As an instance illustrating what I mean, we may cite the case of the measurement of the Atlanta base-line by the engineers of the United States Coast Survey. The whole length of the base-line was nearly six miles, and three determinations of its length showed differences of about 3-10 of an inch—about a millionth of the entire

length. It is safe to say that if these re-measurements had shown differences of ten feet, there would have been no quarreling in regard to which measurement was right, but all would have been rejected, and if the engineers were not dismissed as incompetent, they would, with feelings of mortification, have begun their work over again. It is curious to observe that in many cases where less skillful men attack problems infinitely more complex, reaching conclusions differing as widely as the poles, we have, instead of conscientious re-investigation or a modest reservation of judgment, dogmatic discussions, empty words.

In the other case, where the error is likely to be a fundamental one, the probability of the truth or error of a conclusion cannot always be determined numerically, and will vary greatly in different minds. For instance, A may think he saw a ball dropped into a box, and may feel certain that it is yet there; B is certain that it was a juggler's trick, and that the box is empty; C did not see the act, and has no opinion in the matter. About the *fact* there is no uncertainty: the ball is either in the box or not. No discussion can affect the matter in the least. The uncertainty is purely a mental affair, its degree depending upon the ability of the observers, their opportunities for investigation, and their previous training. Their differences on this subject will be wholly obliterated by an exposure of the interior of the box, and without the necessity for any discussion whatever. If the box *cannot* be opened, the matter will remain a legitimate subject for dispute. The fact that competent men think a subject worthy of dispute seems to me a good indication that the matter is, humanly speaking, uncertain. That unpleasant thing called intolerance, in those cases in which it is accompanied with sincerity, arises from an inability to see these points, and hence we have A making strenuous efforts to convert B and C to his own opinion, failing in which, he proceeds to burn them, to imprison them, to lampoon them in the newspapers, or to do some of the more quiet, but scarcely less effective things, characteristic of our own times, that the spirit of the age will permit. Perhaps no blame is to be attached to such acts. If they are failings, they are simply to be counted in with the other failings to which well meaning men are liable, and when the evil effects fall heavily upon us, it is perhaps wise to endure them with philosophic calmness, along with the other misfortunes which for some reason or other seem incident to human life.

In conclusion, allow me to say, that it seems quite probable that human welfare does not require us to sit in judgment on the ideas of others. Thoughtful men are becoming more and more impressed with the vastness of the unknown, and the comparative insignificance of human achievement, while the demonstrated fallibility of human reason leads them to temperance and modesty of thought and expression; to *appreciation*, as well as toleration, of opposition and doubt. Certain it is, that if we preserve our intellectual integrity, we shall be unable to settle many of the problems that interest us most. If we decide upon some of them, and other persons still reserve their judgment or decide differently, we need not lose our tempers; they have not only decided differently from us, but we have also decided differently from them. It is important to notice that neither of

these decisions has affected the *truth* in the least. If we feel called upon to defend the truth, we are, after all, only defending what we *believe* to be truth, and possibly against men as honest and as able as ourselves. But why should we defend the truth? So long as the heart of humanity shall pulsate, will not truth be cherished there? Why would it not be far better for each one to put himself in the attitude of a reverent *searcher* for truth? remembering always, that the little decisions that we may reach are possibly wrong, that all of the honesty and ability in the world is not concentrated within ourselves, and the comparatively few who think as we do, and that one can do nothing nobler, than to make himself as intelligent and humane as possible, resolutely following out his highest convictions, and living at peace with himself, and with all men.

PHILOSOPHY.

FOOTPRINTS OF PRIMITIVE THOUGHT.

BY JUDGE E. P. WEST, KANSAS CITY.

None of us, perhaps, realize how deeply crystallized in our boasted enlightenment of the nineteenth century are the footprints of primitive thought. We, notwithstanding the growth of human reason has removed some of the shackles which for long ages bound mankind in error, seem utterly incapable of taking in the full scope and consequences of our freedom, but linger amid the scenes of our former enslavement, fearful, or perhaps incapable, of leaving the chains when broken, which have so long bound us in error. As an infant with fear and mistrust essays its first step, which is the promise of its coming manhood, so we seem fearful of following the guidance of our reason—that grandest effort of the mind —the earnest of our coming intellectual manhood, directed by the ineffaceable pathway of truth—sublime, eternal, immutable truth!—evolved from necessity.

We have ceased to use the boomerang, the bow, and the stone spear and ax, but the ideas which originated with them in the infancy of the race, and which are as primitive as the boomerang and the stone spear and axe, have flowed down to us in an unbroken stream from primitive time, and are to-day intermingling with, and forming strong currents, urged by the impetus of past forces, to mar the harmony and placidity of the great ocean of human intelligence. I allude to ideas which, though deeply rooted in our civilization, never could have originated with a race having reached our present degree of intelligence, however limited, comparatively, that intelligence may be. But, we must not infer that all we have inherited from the past is untrue, for conceptions as true as those we entertain to-day have lingered with mankind for long ages.

To comprehend this clearly, we must consider man as he was in the primitive

times as compared with his present condition, and measure the varied stages of his development. And, at the very threshold of the subject, we are met with one prominent idea of almost universal acceptance, which has survived the very limited, or, perhaps, more properly, the very primitive intelligence that could have originated it; I allude to the wide spread error that man was created perfect, but degenerated in his physical and moral nature after his supposed creation upon the earth. Such an idea could not have originated with a race of our present knowledge, predicated upon known facts connected with man's past history, but, having originated in the race's infancy, it has been handed down by tradition, supported by superstition, from generation to generation, until it has become crystallized in our civilization and remains with us without a right exercise of reason, or, perhaps against our reason, supported alone by the glamour of the imaginary mysteries of the very remote past.

It has been less than four thousand years, but a brief moment compared with the great cycles of time in the world's history, since man attained sufficient intelligence to keep a meager written record of the events transpiring around him, and to record his own history. All prior to that time, for long unknown ages after man became man upon the earth, was the mere mythical traditions of an infant race, ignorant alike of their own being and of the workings of the natural forces around them; and whatever written record purports to give a history of man prior to the historic time may be regarded with great mistrust—as simply a synopsis of some of the traditions of a primitive people, recorded in an age just emerging into the historic time, and by historians whose knowledge of natural laws was very little superior to the people whose traditions they attempted to record. The only merit such a record can claim is, that it proceeds from the depths of the past and stands out a conspicuous monument of the errors of infant thought.

We must turn from the traditions of the living to the more trustworthy traditions of the dead, as presented in the vestiges left by man in the past ages, for a true picture of his primitive condition. Everywhere on the earth's crust where civilization holds a footing, there are to be found in the natural caverns and in the tumuli erected by man, vestiges of his former existence, extending back, probably, to the miocene time. During all those long ages, embracing many thousands of years, man can be traced, and the more remote the tracing the less perfect in physical structure and in intelligence we find him to have been. He was incapable, probably, in the very early infancy of the race, of fashioning the very rudest implements for his convenience and defense. He was incapable of clothing himself, for he knew nothing of the manufacture and use of clothing. He was incapable of erecting an artificial structure for a dwelling place, but used the caverns and grottoes which nature had fashioned, for shelter and protection. He knew nothing of the use of fire for warmth or the preparation of his food, but he ate his food raw. He had but little idea of a fixed abode, or of laying up for a rainy day, but gathered a precarious subsistence from the stores of nature around him. In his early struggles for existence, he used only those implements which

nature had fashioned to his hand. Such was the condition of man as traced by the remains he has left all along down the varied stages of his past career. From his primitive condition he emerged slowly, and his advancement is well marked in an unbroken sequence from the palæolithic or rough stone age, in which man began to fashion rough stone implements for his use in war and the chase, to the neolithic or polished stone age, in which he acquired the art of polishing his implements, through the bronze age, in which he acquired the use of metals, down to our present comparatively high place in the still cumulative iron age.

During all these long ages in which man has filled his place in the world's evolution his tendency from a lower to a higher development has been unbroken, very slow at first, indeed in all ages, but with accelerated growth in proportion as his development became more perfect and capable of a wider range of comprehension Who that has studied the tangible vestiges associated with man in the past, can believe for a moment that he has been superior at any former time to what he is in our own generation; if he had been so some token of his superiority would have been left behind him as evidence of his merit. Who can doubt that thousands, nay perhaps millions of years hence, vestiges of our present civilization will not afford unerring evidence of our great superiority over the past generation of man. It is necessary to have a clear conception of man's gradual advancement in order to comprehend more fully many of the ideas which have drifted to us from the past, and still linger with us in our civilization, and exert a marked influence in our mode of thought, and in shaping our conduct. In this connection I may allude to a prominent idea which assumed form comparatively recently in the Abraic branch of the Shemitic race, but which had its germ far back in the primitive time; I allude to the wide spread error which we find ramified in the teachings of all the Abraic and Christian races, and which, though not now believed by the more intelligent, yet retains a firm footing, and is used, not only by the descendants of Abraham and all Christian nations, but by some very intelligent societies, as a date of the world's beginning; I allude to the date, namely, 5639, according to the Jewish reckoning, used to express the world's age. It is unnecessary for me to call the attention of this intelligent audience to the manifest error of this date as presenting either a correct idea of the world's age or of man's duration upon it.

The progression of human intelligence to which I have alluded, has not been accidental or uncertain, but has moved in well defined lines which indicate clearly beyond the boundary of a reasonable doubt, the gradual unfolding and growth of the human intellect, from a very low order to our comparative high degree of development. But, while the general tendency has been steady, there have been intervals of retarded or accelerated advancement. The growth has been, too, in strict conformity with the natural laws of evolution, that is, in those channels which a people would naturally follow, emerging from a lower and passing to a higher order of development.

We may divide this development into five different channels or classes, as represented by ideas, each of which is capable of a further subdivision. namely:

1. Ideas flowing in channels in which the appearance is consonant with, i. e., represents truly the object observed.

2. Ideas of utility, which suggest the fashioning of natural objects for man's practical use.

3. Ideas growing out of, or suggested by the social relations of man with man in aggregate communities.

4. Ideas flowing in channels in which appearance is not consonant with, i. e., does not represent truly the object observed, and

5. Ideas associated with the imagination and emotions, and in this connection, ideas crystallized from tradition.

In the first class may be prominently considered the æsthetic effort of the human genius to reproduce in picture things esteemed of interest, as man, animals, plants, rivers, lakes, mountains, and objects in which the true idea of form, position, &c., is conveyed by the outline of the object. This was among the first of the distinctive efforts of the human genius in a well marked and permanent line of development. Indeed, we find in a much lower order than man, as in some animals and birds, the æsthetic taste strongly marked, but we have no evidence of their advancement, while in man, evidence of progression is marked in every stage of his past history. Among the earliest remains left by primitive man, and associated with the rudest stone implements fashioned by him, are to be found rude efforts at picturing the natural objects around him. This effort, from its rude beginning, as illustrated in its attempt to reproduce in picture the living mastodon, gradually advanced until art had attained a comparatively high place among the ancient Egyptians and Phœnicians of the East, and the Peruvians, in the time of the Incas, of the West, and, until it culminated finally, in a perfection among the Greeks and Romans, more than two thousand years ago, which has not been surpassed in our own time. We may safely assume that the wavy lines of female beauty have never been reproduced with greater perfection than among the ancient Greeks, and we yet borrow with profit from ancient art.

In the second class, may be included a long array of objects useful to man in his various needs in the ordinary walks of life; prominent among which may be named architecture, road making, bridge building, bronze casting, the culinary art, and the construction of textile fabrics. In those useful branches, in which the technical skill employed is of a low order, many of the ancient nations, as the Egyptians, the Chaldeans, Assyrians, Hindoos, Chinese and Peruvians, had, very remotely, made great proficiency, and later, the ancient Greeks and Romans attained a degree of perfection which we may yet, in many respects, copy with profit—a progression by no means unworthy our admiration, when we consider that the first effort at the useful arts consisted, probably, in simply the breaking off the rough corners of a stone to be hurled by the hand in the chase, in war's aggression, or in personal defense against enemies.

As to the third class, whatever differences of opinion there may be as to the causes which lead to man's tendency to aggregate in social communities, it is well known, that from time very remote, his individuality, to a limited extent, has

been merged in the social and political compact, in the relation of tribal, or state government. Aggregation, very soon, suggested the necessity of rules for the government of the aggregated communities, and, rules growing out of usage, improved upon by experience, from generation to generation, finally, after long ages, ripened into maxims for the moral and political government of the people among the most advanced nations, as the Chaldeans, Phœnicians, Egyptians, Chinese, Hindoos, and Jews. And, while the maxims among the advanced nations were not entirely the same, they did not very essentially differ. Among the maxims thus crystallized from usage and experience, which stand most conspicuous in the moral and civil codes of the enlightened and civilized nations, may be reckoned those contained in the Decalogue, the Vedas, and the maxims of Confucius and Laotse.

It will be perceived, that in the three classes which I have considered, that no great technical or scientific skill was required, but the advancement flowed naturally, either from the suggestion of the æsthetic tastes, or from the suggestions of convenience, utility, or necessity, and the advancement made, however great, is little more than improvement from long usage by accumulated experience; and, it need not be a matter of surprise if a proficiency was made two thousand years ago which we have scarcely surpassed in our own time.

The maxims of the Roman law enter largely into the jurisprudence of the civilization of Europe and America, while those of Confucius, and Buddha enter largely into the Mongolian and Indian civilization. So, too, with architecture, sculpture and painting, our civilization derives its ideas in those arts from the ancient Greeks and Romans, while the Chinese and Indian races have scarcely improved on the proficiency they had made two thousand years ago. But, there is one very suggestive and important fact we must not overlook, namely, that infinitely greater advancement has been made, in these branches, in the last five thousand years, than had been previously made in all man's duration of, perhaps, more than a million of years, upon the earth; showing how very slowly the human intellect has emerged from its infancy, and with what accelerated force it has moved, as it has acquired strength. In sculpture and painting, we have made no recent advancement, and the only improvement made in the branches I have considered, in the past two thousand years, has been in government, in architecture, and the domestic arts. In the latter, including architecture, our only improvement has been in practical utility. In this, the advancement in the last century has been very marked. The finely finished, symmetrical and practical domestic implements of to-day, exceed, infinitely, their prototypes of the olden time; as do also our dwellings, in practical convenience and comfort; but, we have simply improved, in this respect, upon ideas which prevailed more than two thousand years ago. In government, our improvement, though marked, is more in promise than in present achievement; I allude to the tendency, by intellectual development, to the equality of all men, intellectually, and in social and political rights. Such equality may be considered visionary, and surely would be, in our present degree of intellectual development, for, so long as we are short of

truth, and are advancing toward it, some will be in advance of others in the race, but, once attained by all, as it surely will be, in the great evolution of time, all that the mind is capable of grasping will have been grasped, and equality, where all have attained the same intellectual plane, will necessarily follow.

But, long before this attainment, the great tendency now going on, in the civilized world, toward exact legal justice and equality, growing out of the increased intelligence and self-reliance of the great masses, will have been achieved by a universal practical recognition of these great principles of right. The legal and social distinctions which prevailed in the past, and which we yet inherit, to a limited degree, from our primitive ancestors, will have passed entirely away, and universal toleration of opinion and perfect social and political equality, will be recognized, for the intelligence of the great mass of mankind will have reached a plane intellectually high enough to demand it. The advance we have made in government, is toward the recognition of the equality of all men.

In the fourth class, namely: ideas flowing in channels in which appearance is not consonant with, i. e., does not represent, truly, the object observed, may be included the whole field of chemistry and astronomy, as applied to the visible universe. It is in this vast field, extending from the lowest molecule of matter, to the largest aggregate body, that the human mind is most at fault, and still inherits, most strongly, the errors of primitive time. This is not to be wondered at, when we consider that chemistry has had a true scientific growth of but little more than two centuries, while astronomy, as a science, can claim little more than three hundred years since the genius of Copernicus, wandering out of the mere appearance of things, grasped, and the genius of Gallileo afterward demonstrated, a true conception of the form and movements of the bodies composing our solar system.

Most prominent among the errors of this class, and which have left a deep impression on the entire human race in all ages, is the idea of fixity in the visible universe, and the idea that all material things had a definite beginning—a literal creation from nothing—and will suffer, at some future time, utter annihilation. These ideas could not have originated with a people of our present knowledge of the natural laws governing the grand universe of matter, but, being deeply rooted in the primitive mind, they have passed, by inheritance, to our own generation, and still cling to the great mass of mankind, with a pertinacity which the most intelligent have scarcely escaped from. They, too, are the groundwork of most of the errors which have descended to us from our primitive ancestors, and which still obscure and retard a true conception of our place in the great evolution of time.

Man's first impressions, after he became capable of definite ideas of the visible universe, were in harmony with the mere appearance of things, consequently, each individual supposed the world to be flat, and himself in the center of a vast plane, around which the sun and moon, and innumerable small, insignificant stars, made for ornament, were destined to revolve, at a distance of a few hundred miles at most, above the observer. Oceans, lakes, rivers, mountains, rocks,

earth, all were supposed to be made, and located definitely, as seen. Animals and plants were supposed to have been reproduced, without variability, from the creation, to the time of the beholder. I may venture to say, we have not now, in our common schools, a boy ten years old, who does not know that these impressions are wrong, although they prevailed, almost universally, to within two short centuries ago, and still prevailed very largely, among the masses, within the last half century, and, I may add, are entertained by some of to-day, among the most enlightened nations of the world. We have overcome some of the simpler of the errors of our ancestors, and have somewhat enlarged our intellectual prison bounds, but, we are yet far short of perfect freedom, for the most intelligent seem yet limited by the idea that the present phase of the solar system was the ultimate aim of its creation. It matters not whether the belief is that creation was accomplished in six days, or in six long geological ages, the idea of a definite beginning, from nothing, and ultimate annihilation is, all the same, fixed and well defined. The introduction of matter is considered a kind of short interlude between infinite time, preceding its introduction, and infinite time which is to follow its destruction. The interlude, according to the generally received opinion, was for man's introduction upon the stage, but, it would seem, he egregiously failed in his part in the great drama. The outside unlimited expanse of worlds was scarcely taken into the account at all, but was considered a kind of decoration for the earth, or, at most, for the solar system; and the idea of their real entity, now that their true character is known, is little less vague and unreal. We have somewhat enlarged the boundary of our knowledge, but it must be confessed that these ideas have as little foundation in fact, and are as crude in respect to the real entity of the visible univer e, as some of those we have discarded.

We have no right to assume that matter can be annihilated, for the universal experience of mankind is, that, while it is capable of almost infinite change, it cannot be destroyed. If matter is, and is incapable of destruction, we have a right to assume that it has always had a being, and will continue forever to be—that matter is Infinite! If we assume the infinity of matter, as we may do, if we assume its being, and indestructibility, and, if we further assume that the matter of the solar system, at some time in the past, entered upon its present phase, and, that the present phase will terminate some time in the future, we have a right to assume its capability of entering upon, and passing through, other similar phases—that it may have done so in time precedent, and may do so again in time to come.

The creationists have a well defined belief, that for infinite time, preceding the introduction of the matter of our world, and for infinite time which is to follow its annihilation, nothing material existed, or will exist; that in its present phase, matter had its definite beginning, and will have its definite annihilation and ending. He looks upon material things as a brief tempest of discordant energy, introduced in the lull of infinite time and reign of pure intelligence.

In contrast with these vague, unreal ideas, coming to us from the past, we now know that the stars, filling the outside depths of infinite space, as far as we are

are capable of scanning them with the highest magnifying power known to us, are real suns, composed as our own sun, and many of them exceeding him many fold in magnitude and energy; and we have a right to assume that they are centers of other systems of worlds, not very materially unlike ours, governed by the same laws, and the same destiny.

Admitting the nebular hypothesis to be true, and nothing accounts so well for all the phenomena attending the solar system, we must infer that all the heat now stored in the laboratories of the sun and his attendant planets, and their satellites, will ultimately be dissipated by radiation, and all the bodies composing the system, become dead matter, destitute of light, heat, and every kind of energy, save the ever persistent force of gravity, and their diminished orbital motions. The darkness of night will prevail, and without a sound to disturb the awful stillness, which will pervade the mighty depths of our system, the bodies composing it will move in silence and darkness, drawn by the relentless force of gravity, to a catastrophe the most stupendous that our worlds are capable of—a catastrophe no less than the change of the entire dead, inert matter of our system to a living energy. Suppose the repulsive force of heat entirely exhausted in our solar system, and the unresisted force of gravity continuing to work, we may assume that the bodies comprising it would be drawn together by one of two methods, namely, by a sudden, direct and violent concussion, or by a gradual approach, maintaining their orbital motions, until they became united in one body. The consequences following either mode of union can hardly be doubtful. If hurled suddenly and violently together, at a velocity which would necessarily obtain by such mode of union, the impact would generate heat enough to throw off the entire mass in a gaseous condition; if, on the contrary, the approach to a union in one body was gradual, the pressure incident upon unresisted attraction, would be so great as to generate a heat capable of converting all into a gaseous state. Unresisted pressure, or violent concussion, either, is capable of converting matter, which has satisfied its chemical energy, into new activity, or, more correctly, into new molecular vibration. Shall we assume that the matter of the solar system, after this short phase of its existence, will be annihilated, or, that, after exhausting its energy, will assume a passive state, in which it will continue forever, or, that its present condition of energy has continued for infinite time in the past, and will continue for infinite time to come. Neither of these assumptions is tenable, while the idea of renewed energy, or the transfer of energy from aggregation to limited expansion, is in harmony with all the phenomena of the solar system and with all the facts which we have drawn from the starry depths beyond. It has been the grand privilege of this generation, to witness the transfer of energy from aggregation to expansion, in the domain of a distant sun. On the evening of the 24th of November, 1876, in the constellation Cygnus, there suddenly burst out from the darkness of night, a flame of light—a new nebula, the incipient energy—renewed from the ultimate limit of aggregation—which is to form, in the great cycle of time, new worlds and a new sun, destined to play their ever varying parts in the great drama of renewed life. In drawing a com-

parison between a new star, which appeared in the year 1866, in the Northern Crown, and the new star I have alluded to, in the constellation Cygnus, Prof. Proctor, of the Royal Observatory of London, says: "Let it also be noticed, that the changes which had been observed thus far, were altogether unlike those which had been observed in the case of the star of the Northern Crown, and, therefore, cannot justly be regarded as pointing to the same explanation. As the star in the Crown faded from view, the bright lines, indicative of glowing hydrogen, died out, and only the ordinary stellar spectrum remained. In the case of the star in the Swan, the part of the spectrum, corresponding to stellar light, faded gradually from view, and bright lines, only, were left, at least as conspicuous parts of the star's spectrum. So that, whereas, one star seemed to have faded into a faint star, the other seemed fading out into nebulæ—not merely passing into such a condition as to shine with light indicative of gaseity, but actually so changing as to shine with light of the very tints (or more strictly, of the very wave lengths) observed in all the gaseous nebulæ." But, the eventful history of this new star did not end here, but it still continues to shine with true nebular light.

In contrast with the vague notions which we still cherish, and adhere to, as inherited from the past, we may assume the universe of matter to be infinite, and capable of infinite change. We may assume that our own solar system is but one of innumerable systems filling universal space, and liable to the same destiny. We may assume that the bodies, or matter composing the various systems of the universe, are in every stage of development, or more properly, molecular activity, all the way from dead worlds, groping in profound darkness and silence, to the highest degree of molecular energy—that, like the fabled Phœnix, worlds, and systems of worlds, spring into new life and energy, from the ashes of their own ruin.

I must invite your attention to another important fact, before closing this branch of the subject, namely, that while the growth of the human intellect has been slow and gradual, as directed and advanced by usage and accumulated experience, in the first three branches I have considered, the approach to true conceptions of the form and motion of the heavenly bodies, and their chemical combinations, was presented suddenly to the human comprehension, through the genius of a Mayer, a Copernicus and a Galileo, after the intellect had attained sufficient growth to grasp and weigh abstract ideas by true scientific methods.

I have consumed so much of your time, with all the brevity I could use, in treating the former branches of my subject, that I shall have to be very brief in considering the last division, namely: Ideas associated with the imagination and emotions, and ideas crystallized from tradition. The imagination has been, in all ages, a fruitful source of brain conception, and of giving form and color to the ideas conceived. It may be regarded as a pilot, which invites the following of the more prosaic verification of the truths which science unfolds in nature. Its following is often deceptive, and, sometimes, after long voyages of pleasing delusion, leads to the utter wreck and ruin of long cherished opinions; but, it must

not be discarded because it has sometimes led to rocks and quicksands, which have wrecked the voyager, for, notwithstanding its some-time delusions, it has often led into safe harbors of scientific verification and truth. It has preceded some of the most important of our scientific discoveries, and is closely allied with human progression. It has anticipated the greatest pleasures, and pictured the wildest horrors. It revels in the most trivial affairs of life, and goes boldly out, in defiance of time and space, and all material things, to people unknown realms with ethereal beings. Aided by the emotions, it has given to airy nothings a "habitation and a name." It has located for the American aborigines, a happy hunting ground, where the shade of the departed warrior enjoys an eternity of bliss, basking in the smiles of the Great Spirit. It has, for centuries, kept the watchfires burning among the Aztec races, awaiting the return of a Montezuma. It has erected a seventh heaven for the eternal repose of the true Mahommedan believer. It has filled the surrounding air with the spirits of the departed ancestors of the Chinaman, to exercise a malign or good influence over the destinies of the living. It has located habitations of never-ending, and unchanging, states of bliss, and has fixed prison domains of perpetual torture, from which escape is hopeless. It has created, and individualized, supernatural beings, in the realms beyond, possessing every degree of power, and endowed with every shade of malign or good influence over the destinies of men. It has limited, in the early stages of its development, the great universe of matter to our own world, and made it the grand central figure of all material things, and man as the crowning work and aim of its conception. These ideas, short as they are of the real grandeur of infinite nature, have become concrete from tradition, handed down in the remote past, from generation to generation, among various nations and tribes according to their respective beliefs. But the wildest stretch of the imagination is far short of the grand reality in nature,

> Which, ocean after ocean of different density unfolds,
> To form in all nature, and infinity, "one stupendous whole."

ON SCIENCE AND MAN, WITH SPECIAL REFERENCE TO PROF. TYNDALL'S LATE ADDRESS.*

BY REV. NOAH PORTER, D. D., PRESIDENT OF YALE COLLEGE.

We observe, before the argument of Prof. Tyndall begins, a little skirmishing. In speaking of the dependence of the individual upon the forces of the past, Prof. Tyndall says that Boyle regarded the universe as a machine, but Mr. Carlyle prefers to regard it as a tree, and adds: "A machine may be defined as an organism with life and direction outside; a tree may be defined as an organism with life and direction within. I close with the conception of Carlyle. The order and energy of the universe I hold to be inherent and not imposed from

*Read before the Victoria Institute in London.

without—the expression of fixed law and not of arbitrary will." In speaking thus he forgets that to a great majority of scientists the very conception of an organism implies external intelligence, and his confusion of mechanical with organic relations becomes apparent in his further remark that "the interdependence (of the sciences) of our day has become quantitative—expressible by numbers—leading directly into that inexplorable reign of law which so many gentle people regard with dread." In his subsequent argument every position is chosen in such a way as to induce the conclusion that the universe of matter and spirit, including the phenomena of moral conviction and feeling, as also of religious emotion and faith, is wholly subject to no other than mechanical laws. At this point the argument proper begins; hitherto all has been but preparation. He now traces and illustrates the doctrine of the correlation of physical forces. He considers next the analagous interchange of decomposition and combustion in the use of the galvanic battery for chemical results—illustrating the truth that chemical elements which are united in combustion at one point in the circuit are liberated in exact equivalents at the other. Having taken two steps in his argument, he essays a third, and suggests that the same process under similar laws may go on in the body of man. Having demonstrated that heat is interchangeable with mechanical energy in mathematical equivalents, and that combustion involving heat is in like manner interchangeable with chemical decompositions, he abruptly asks: "Is the animal body then to be classed among machines?" The friction wheel of the galvanic battery only distributes force—transferring it from one point to another, and varying its manifestations to the senses—but never creating it. Does the animal do anything more? "When I lift a weight, or throw a stone, or climb a mountain, or wrestle with my comrade, am I not conscious of actually creating and expending force?" The ingenuity of thus putting his case is altogether admirable. The man who asserts that the body only transfers force must own that it is a machine; the man who denies that it is a machine must hold that it can of itself generate—*i. e.*, originate—muscular force. The merest tyro in logic would be wary enough to say: I am not prepared to say that A is either B or C, for it may possibly be either B, C, or C plus D. That is, the human body may be something else than either a generator or a transmuter of force—it may perhaps perform other offices than a friction wheel or a galvanic battery. Prof. Tyndall having shaped his major premise to suit himself, proceeds to discuss the minor premise by asking whether the human body generates mechanical force. He answers his own questions by an elaborate and varied series of illustrations, all of which are designed to show that mechanical force and heat and chemism are related to one another in the human body precisely as in the friction wheel or galvanic battery, and that the body falls into the category of machines. This may all be true so far as the production of muscular power is concerned. But within the body other work is done that, according to Tyndall and Mayer and all the scientific world, is a special function accorded to the nerves—over and above any which the correlation of forces can illustrate under mechanical law in the machine or chemical decomposition in

the battery—and this is a function of directing, *i. e.*, of liberating and detaining muscular force—which is illustrated by lifting a valve or pulling a trigger. It were well illustrated by the power of a band to carry motion in a machine or of wire to transfer potential motion or potential heat in a battery. It is very evident that when Prof. Tyndall began his argument, which was to prove that "the body falls under the category of machines," and that as a machine it generates no force, he thought of no other function as possible except the two—of generating or transforming force. Now seeing that his body does through the nerves perform the additional function of directing or transferring force, of determining when and where it should act, he meets this indefinitely conceived demand by the convenient image or picture of a valve, a detent in a machine or a trigger in a musket.

He ought to have bethought himself and corrected the premises of his disjunctive, and, instead of asserting the animal body either creates force or transforms force, he should have said the human body either creates force or transforms force or also directs force. Then, in order to prove that it is a machine, he must prove that it directs force through the nerves by either mechanical or chemical agency. This last he does not attempt to do. He does, indeed, assume that nerve substance is wasted by use, and implies that heat is probably evolved in nerve activity, but in all this there is not the slightest attempt to explain by what mechanical process the nerves direct or transfer motion. The body is accepted as a finished machine, now ready for the "kindling of consciousness," which may turn out to be a form of heat evolved by mechanical laws. Under this notion he marches boldly up to the new line of inquiry which relates to the connection between this machine and a highly poetic or idealized force, sometimes called the soul. In this examination he is far from successful; for the question is not whether the body, so far as it is material, is subject to material laws, but whether it is not also a living body, and what forces, relations and laws this conception implies.

What is most surprising is, not that a certain class of scientific men do not see this distinction, but that so many insist in one breath that no scientific theory can be accepted which is incapable of mathematical formulation and experimental verification, and in the next breath adopt a theory of life on a mechanical and chemical basis, the laws of which they do not profess to have formulated in numbers nor to have tested the alleged facts by experiment. Prof. Tyndall insists that "the interdependence of our day has become quantitative—expressible by numbers," and that where law cannot be formulated by numbers there is no science. We insist that if under this definition psychology, morals and theology are excluded from the domain of science, physiology should be excluded also, and yet the whole doctrine of development, with heredity and its variations and integrations, and all the nomenclature by which the soul is demonstrated to be but a higher potency of matter, and personality to be an ideal fiction, and God an entirely superfluous hypothesis—is derived from the very

operations of life, scarcely a single one of which if tried by the criterion in question has been scientifically fixed or formulated.

But where do the supposed relations between the machine-body and the soul begin? Prof. Tyndall, speaking of the case of a man who receives bad news in a letter, and springs up and hastens to save his fortune from wreck, says that the whole of the emotional, intellectual and mechanical action of the body was caused by the impact upon the retina of the infinitesimal waves of light coming from a few pencil marks on a bit of paper. He assumes that terror, hope and all the emotions through which the man goes are caused by the impact of the undulating light upon the responsive retina; that this imparts another impact to a somewhat ceasing terror, which in its turn by another stroke or impact is transformed into hope, till at last the latch is lifted, the muscular power is set free and the man springs to his feet. This assumption concerning all these processes resolves them into mechanism and subjects them to the law of necessity. It takes for granted that whatever the soul may be, its phenomena are caused at first by the impact of a material object and follow in succession according to mechanical necessity. The proper attitude to assume is that of protest against every such assumption. The true and wary philosopher will say just at this point: I do not accept your version of these intervening phenomena; they are in no sense evoked by the object striking upon the man, but they are performed by the man with reference to the object. It is not the letter which strikes its impacts upon the man, but it is the man who reads the letter and thereafter acts in calculation and hope until the latch is lifted and the muscular motion is set free. We know that this view is very strange to Prof. Tyndall's method of philosophizing and is fatal to all his conclusions, but in our view it is true to the facts, and we must protest against this stealthy, even if it be an unconscious, way of discussing the facts by the mode of asking the question, whence the impulse and how did it originate, that directs or liberates motion in the various methods so vividly described? This is indeed the critical question. It is none other than whether there is any other agent than matter, and whether the agent, be it material or aught besides, acts according to mechanical laws and under mechanical necessity. How does Professor Tyndall answer this question? He remarks first of all, "The aim and effort of science is to explain the unknown in terms of the known. Explanation, therefore is conditioned by knowledge." This truth he proceeds to illustrate by the story of a German peasant, who, when he saw a locomotive for the first time, having never known any other than animal power, after long reflection solemnly said: "There are horses inside!" The story in Prof. Tyndall's opinion illustrates a deep-lying truth. It strikes us that the deep lying truth which Prof. Tyndall finds in it admits of an application to himself. Had the peasant known no other locomotive power than that by horses he had reasoned wisely, provided the peculiarity of the effect was not fitted to awaken a suspicion that there were some things he did not know. When Prof. Tyndall insists that all the functions of the animal body are explainable by mechanical or galvanic agency, he seems to say, "There are horses inside. I know only of

motion, heat, breathing and eating, and these only are the forces I accept." Hope and terror are unknown qualities to science, and can neither explain other phenomena nor be explained, and the reason why we cannot unite them in a causal connection is that while we can form a coherent picture of physical processes we can form none of a molecule producing a state of consciousness acting on a molecule, and physical science offers no justification for either of these connections. Now, if by picturing the soul or the mind is intended that it cannot be pictured as occupying space and as affecting the bodily senses, i. e., cannot be imagined as material substance, this is true; but if it is contended that the mind cannot be pictured as the mind finds itself in its operations, then it is untrue, and that it is untrue is affirmed by Prof. Tyndall himself every time in this discourse he says I see, or know, or remember, or believe. If he means that he cannot picture the mind as acting, we reply that he can picture the acting of the mind as truly as he can picture the acting of the body. If he attempts to picture what he means by force, whether galvanic or mechanical, he will find this as difficult as when he attempts to picture mental force. If he cannot picture mind as acting upon matter, or matter acting on mind, no more can he picture matter acting on matter. If he says that he knows nothing about mind, and that therefore psychical existence and psychical action can not be used to explain any phenomena, because this would be to explain the unknown by that which is more unknown, he refutes himself every time that the words *to know* escape from his lips. And if we know nothing of the knowing process or knowing agent, what confidence can we have in what it knows of matter? To say that all this agent can know is matter is to beg the question, while in the very terms in which we beg it we assume that that function which we call knowledge gives law and authority to itself and the science which it creates. Prof. Tyndall's argument, carried into the domain of morals and psychology, results in his conclusion, that "following the lead of physical science, we are brought without solution of continuity into the presence of problems which, as usually classified, lie entirely outside the domain of physics. To these problems thoughtful and penetrating minds are now applying those methods of research which in physical science have proved their truth by their fruit. There is on all hands a growing repugnance to invoke the supernatural in accounting for the phenomena of human life and the thoughtful minds just referred to, finding no trace of evidence in favor of any other origin, are driven to seek in the interaction of social forces the genesis and development of man's moral nature." The careful reader will observe in these concluding words the affirmation for the first time in any of Prof. Tyndall's writings, of the tenet that moral distinctions are the product of social agencies. That he must of neessity hold this opinion was clearly enough to be seen by any one who follows the logic of Atheistic Evolutionism, to which Prof. Tyndall professes that he has been led with so many other thoughtful minds by scientific necessity. Thus has Prof. Tyndall been led to the following answers to the problems of mind and matter:

Negatively there is no spirit, no freedom, no God and no immortality, and

positively the scientific and practical explanation of the past and the promise of a future lie in a blind force working under the law of progress for man's amelioration, as the result of whose workings the idea of moral good is in due time developed, in whose name law is administered without justice. Morality as a social product creates religion, which rules by relentless force without personal sympathy.

The argument consists of four divisions. Of these divisions the first recapitulates the history and evidence of the conversation and correlation of force in the domain of physics. In this argument Prof. Tyndall is at home. His statements are clear, his examples are pertinent and the experiments are manifest. We will admit that the argument is decisive. The second division is that in which he agrees that the animal body is a machine, which is controlled by those forces and only those forces, and obeys those laws and only those laws, which are found in the inorganic sphere. This argument seems defective, in that it omits many of the phenomena which are most characteristic of the animal body, and transfers analogies from one physiological function to another, with an intellectual haste and audacity which are utterly foreign to the methods of physical science, or indeed of any science, whether pure or applied. The third division declares that all those phenomena called psychical should be treated by the scientific man as utterly unknown—as incapable themselves of being explained by any other than natural forces and laws, and of being stated in any other than figures of poetic ideality. This position he does not argue. He simply begs the conclusion, and not only this, but he dishonors science itself by this very assumption, because he dishonors the agent which is the Creator of science, and by his own sovereignty is the law-giver of science, imposing upon its own work the methods of procedure, and declaring the manifold services, Prof. Tyndall himself being witness, which theory, question, imagination and experiment have contributed towards its triumphs. Moreover, he asserts that the soul, though potent and sovereign in these creations, is nothing but an idealized abstraction. The fourth division consists of a rambling and somewhat incoherent argument, which we have endeavored to condense, upon the higher themes of man's responsibility to himself, his fellow-men and to God. In all this part of the discourse there is not the slightest suggestion of the methods of induction or experiment, such as are pursued in physical science. There is not a single example of those analogies which open to the sagacious interpretations of scientific genius, glimpses of a brilliant speculative theory. The four divisions of the argument are held together by the foregone conclusion that the devotee of science may recognize nothing in the universe, but matter, fate and evolution. In the first of these divisions Prof. Tyndall writes as a physicist, clearly and consistently. In the second as a physiologist, and here he is limited in his recognition of vital phenomena and committed to the foregone conclusion that life can be explained by mechanism. In the third, as a psychologist, he is a sturdy materialist in his reasonings and a poetical abstractionist in his concessions. In the fourth he is a moralist, metaphysician and a theologian, and as a moralist accepts the hard theory of Hobbes

as made flexible by Darwin and Spencer. As a metaphysician he is a fatalistic evolutionist with a dash of imaginative optimism, and as a theologian he is a sentimental atheist or an imaginative agnostic. In each of these several capacities he dexterously shifts from one phase to another, according to the varying needs and aspects of his argument. No man has insisted more strongly than he upon the necessity of mathematical formulization to fix whatever laws are surmised and of rigid experiment to test and confirm the most plausible generalizations. In this address he seems to have forgotten to exemplify the first article of his own philosophic creed, and to have wofully failed to apply the tests of experimental verification.

ARCHÆOLOGY.

THE ORIGIN OF METALLURGY—THE BRONZE AGE.

[*Continued.*]

We will now speak of the places where products of bronze industry were found. The first steps of science were difficult and uncertain, because discoveries were made by mere chance and by inexperienced men, who very often sold their antiquities by weight, and sometimes destroyed them even. Thus in 1859, on a farm of M. de Gourgue, near Bordeaux, "the husbandmen on returning from the fields, told their master that during the day they had found a corpse, that they tried to smash its head with their sabots, but it was so big and hard that they could succeed only with their spades." They brought back with them, however, a hatchet, a sword, golden threads and fragments of pottery. The following occurred in 1865 at the celebrated pre-historic foundry of Larnaud (Jura), "Brenot fils, while digging potatoes, discovered a piece of green metal which excited his curiosity and that of his friends. They set to work and found a quantity of objects of the same metal within a plot one meter square. The next day Brenot père took a specimen to Lons-le-Saulnier, a brazier, who told him the bronze was worth forty cents a kilogramme. On this man's suggestion, Brenot offered his treasure-trove to an amateur of Antiquities, M. Z. Robert, who did not hesitate to take them. There were about eighteen hundred pieces, weighing 66½ kilogrammes." All this bronze came near being thrown into the crucible of the founder. It is now in the museum St. Germain, and is one of the most interesting collections. One more incident may be given. The ancient foundry of Vernaison (Rhone) was found in 1856 on the property of M. D——. The total weight of the bronze was 16 kilogrammes, but the director of the Lyons museum at that time, retained only a small portion. "We have selected," said he

"the complete, or mutilated objects most worthy, to adorn the museum, the rest was returned to M. D——, who proposes so have cast a commemorative urn, with an inscription recalling the event of the discovery." Notwithstanding the dangers by which the prehistoric science was surrounded, the bronzes in France and Savoy are already so numerous and so well characterized, that M. E. Chantre has been able to class them into categories which we divide into two groups: the *visible strata*, and the *hidden strata*. The first comprises grottoes, dolmens and palafittes or lacustrial habitations; the second, treasures, foundries, isolated stations and tombs in open fields.

It is well known that caves formed the first habitations of man, not only during the stone, but also the bronze age. Throughout Europe inhabited caves are found. The most interesting, perhaps, are those of Central France and on the banks of the Meuse. The latter have the advantage of being in three planes, representing three successive risings of the river which irrigated its banks. They present supposed layers of human remains of three consecutive epochs; that of metal, of polished stone, and of rough stone. The latter, which is beneath the other two, is no longer found on a level with the other two layers which were then beneath the water, for the Meuse at Dinant was not less than three leagues wid . Among the human remains there are bones of mammoths, hyenas, reindeer, animals which were then in France and Belgium. The inhabitants of the caves made earthen vases, but knew not the art of baking them, although they had fires. M. Dupont, (L'homme pendant l'age de la pierre) from whom the following is obtained, estimates that during the period of the mammoths, the width of the Meuse at Dinant decreased from 12 kilometers to 400 meters, which is the distance of the caves in the center. To-day it is but thirty meters. The middle layers just beneath those of the mammoth, correspond to the period of the rein-deer, the grottoes, which are termed pits of the Mitons, of Chaleaux, of Frontal, are striking examples. The remains of human industry are buried beneath a bed of yellow clay which covers them. In these no bones of mammoths or hyenas are found, but only those of some species now living; the wolf, fox, deer, wild goat and rein-deer. There are not yet any polished stones; there is no trace of metals; the potteries are made by hand but are not baked; small stones, pieces of bone, teeth of animals, or fossil shells with holes, composed the ornaments of those people. The third layer, corresponding to the interior caverns on the borders of the Meuse, is that of polished stone; it is the epoch of dolmens and lacustrial cities of Switzerland, Savoy and Italy. Yellow clay disappears, the rein-deer, elk, wild bull, and castor have all disappeared. The hatchets are made of polished stones with holes for inserting handles; the potteries are now baked. This epoch has left behind but little remains in caverns, but much is found in the earth of the fields. It is here that bronze makes its first appearance, and though scarce in Belgium, is found in great quantities in Central Countries. The caves of the bronze age in France and Savoy are of two kinds, those used as dwellings and those, whether natural or artificial, for sepulchral purposes. As on the Meuse, the inhabited pits of the middle states are

found along rivers, and belong generally to the period of transition from polished stone to bronze. They are scarce, and among the most important are those of Saint Saturnin, a large neolithic station above Chambery, those of Savigny near Albano, of la Salette, and of Louvaresse (Iseria). The people of the neolithic period who witnessed the arrival of bronze, inhabited the plains, and often the borders of rivers. The banks of the Saone furnish us with many stations, o which the successive epochs appear in superposed layers; it is especially at the confluence of streams and about fords that they may be perceived.

Where the waters were tranquil, and produced but few changes, that is to say, near the lakes, the men of that period no longer used caves. They deserted terra firma and built houses above water, resting on piles. None are seen on the steep banks of lakes, as the water is there too deep, but they are found on shallow banks of sand or earth where the water is not profound, as in fords of rivers. What could have induced those men to isolate themselves in the middle of these lakes? We have not yet learned, but it is to be hoped that new observations will solve the problem. However it may be, we perceive that this custom lasted a long while, as the palafittes of the Alps comprise not only the epoch of bronze, but those which had preceded it, and those also which mark the arrival of iron. There are palafittes of the stone age at the lake of Zurich, of the bronze age at Limau, of the iron age at Neufchatel, and each of these periods is well characterized. There are certain lacustrial habitations belonging to the two periods of transition which mark the beginning and end of the bronze age, so that it is at least certain that the custom of living over water continued without interruption for a long time.

As there were found habitations built on piles in the north and center of Italy, it would be interesting to explore the lakes of Central Europe, of Greece and Asia minor, and determine how far the custom extended.

The men of the stone age consecrated natural grottoes for burial purposes, while they also made use of caves for dwellings. Thus on the Meuse, the small cave of Frontal was used as a cemetery for the men who dwelt in the cave of the Noutons. This mode of living was still existing at the appearance of bronze. This is proved by the "Grotte des Morts" near Sauve (Gard). Since 1795 d'Hombre Firmas had called the attention of geologists to this cave, but it was examined only in 1869. M. Tessier died during the first clearing out, which was afterwards accomplished in the name of the Scientific Society of Alais by Messrs. Cazalis de Fondouce and Ollier de Marichard. The cave is a sort of vertical well dug out by nature in a crevice of inferior lias. From this there have been dug a large number of bones of men, foxes, wolves, wild boars, horses, sheep, a complete funeral accoutrement, composed of arms and tools of silex, bom, or deer's horn; a quantity of jet jewelry or of black or green marble, spath and Alabaster, an awl of bronze and many iron pearls many of which were left behind with the rubbish. We will also mention among the natural caves of the first bronze period those of Labry and Baniere (Jard) which have brought to light objects similar to those already found, besides a poignard, ear-rings and bracelets of

bronze, and the caves of Gonfaron and Chateau double (Var). That of Saint Jean d'Alcas (Aveyron) discovered in 1838, was searched in 1865 by M. Gazalio. It is partly artificial. At the entrance there had been placed two large arched stones supporting the roof and forming a triangular entrance. One unfortunately has been taken away by the owner of the cave, and used as a door-step to his kiln. Among the numerous objects thrown out with the dirt by the same person, there have been picked, mingled with bones and silex, two hatchets of polished stone, pearls, a spiral and bronze ring.

The artificial sepulchral grottoes have received the name of covered alleys (allees couvertes). They are especially found in Provence, dug out of the small calcareous masonry-works which appear as islets in the fertile plains of Arles. They consist of an oval gallery open above; the walls are inclined towards each other; the top being covered with large flat stones which must, in the first place, have been covered with earth. One of them, the Grotto of Cordes, which is also called the grotto of fairies, was in turn supposed to be a Gallo-Roman cave, a Saracen prison, a Druidic monument, and, lastly, a sepulchral Grotto of Asiatic or Phœnician origin. "You first of all descend," says Mr. Cazalis, "on large rough stairs into a fore court, uncovered at present, which is in the shape of a sword; from thence you proceed, through a gallery six meters long, into the cave proper. At the mouth it is 3.80 meters wide but narrows in the rear; the walls are sloping. This trench, which is twenty-four meters long, is covered by inclined stones and the whole covered by a tumulus which is much worn. The total length is not less than 54 meters." Unfortunately, the funeral outfits of this cave were scattered, so that the epoch cannot be determined, except by its resemblance to the Grotto of Castelet in the neighborhood. The latter contained sixty centimeters (2.6634 inches) of earth and gravel, brought, to all appearances, from Gardon. On this lay the bones of about ten men, together with instruments of silex and bronze, and a saucer of pottery made by hand. For a long time *Dolmens* were looked upon as Druidic altars, a vague term which with the words "Celtic" and "Gallo-Roman" is indiscriminately used. Since they have been found, not only in Western Europe, but throughout the whole Continent, Africa and Asia, new theories have been current. Some scientists have looked upon them as spontaneous transformations from caves; others thought they recognized, from their distribution over the old Continent, the migrations of a wandering tribe, which, driven from Central Asia, would have followed the Baltic, stopping in Scandinavia, and which would then, driven from the Northern countries, England and Ireland, arrive in Gaul, then proceed to Portugal, and finally to Africa. We do not suppose that dolmens have as yet been the subject of sufficient observation in Africa and throughout Asia, nor even in the different parts of Europe, that any theory should already be substantiated.

The monuments which have received the appellation of megalithic, nearly all belong to the period of polished stone; still a large number date from the appearance of bronze. Those of the North are generally the oldest; and if we may judge of their relative dates by the quantity and quality of bronze which has been

obtained, their antiquity diminishes in proportion as you descend from North to South. This does not prove however, that dolmens originated with a race descended from the Northern countries; it would on the contrary intimate that bronze brought from the Mediterranean countries, reached the North only by slow degrees. There are 147 dolmens in the South of France in which bronze has been found: they are mostly situated in the region of Cevennes, a short distance from the Mediterranean. Several dolmens from Marne and the environs of Neufchatel have also yielded some. Those of Bretagne, with the exception of a few in which a little metal was found, belong to the neolithic period. The 147 dolmens in which bronze was found mingled with objects of stone, pottery of the second period and other objects which will be mentioned further on, form but a minority of the great number which have been explored. In the South of France alone, 700 have been opened in Ardeche, 300 in Aveyron, 160 in Lozere. It may be taken for granted, that if all belong to the period of polished stone, the people who built them witnessed the arrival, in small quantities perhaps, of the first common metal. If they had had it in abundance, they would in all probability have made arms, instruments and even ornaments of bronze instead of stone, shell, horn, or bone, for with a silicious saw they could accomplish in one day of hard labor, what with a bronze saw they could do in an hour, with an iron saw in a few minutes, and in a few seconds with a steel saw impelled by mechanical force. Let us suppose it is yet the custom to bury with a person the objects he has used during his life time, and that in five or six thousand years our graves should be opened, many circular saws would be found in England, France, Switzerland, Germany, but few in Italy, especially towards the South, still fewer in Spain, one or two in Greece, and not one perhaps throughout European and Asiatic Turkey. We do not, however, notice any migrations in our midst; the industries themselves are propagated, but the people do not migrate; a few men passing from one country to another suffice to introduce new industries. The composition of dolmens is uniform, only that bronze increases from North to South; it seems then that there existed in the Mediterranean regions, or beyond, a country from which bronze is brought and distributed throughout the Northwest of Europe.

We must now speak, from the numerous facts collected and classed by M. Chantre, of the beds of bronze which were hidden under ground and brought to light by mere chance. They are of two kinds: the *foundries* and the *tresors*, to which may be added certain stations or centers of habitation as yet not well classified, and a number of tombs in open fields, whose presence there is nothing to indicate. A foundry consists ordinarily of a mere cavity dug out of the earth, and contains, more or less complete, the materials of a bronze-founder; ingots of metal, refuse and waste metal, ashes, fragments of things of little value or worn out, or defective, and, finally, crucibles, moulds, pincers, and sometimes even new objects coming out of the moulds and incomplete. Many of such foundries have been discovered in parts of Europe, especially in France, Savoy and Germany. Should the place and statistics of each be desired, I would refer the

reader to the book above cited. The foundry of Larnaud will serve as a specimen. I have already stated how the son of Brenot the farmer, discovered it in 1865, and how, when offered by his father to a brazier of Lons-le-Saulnier it was saved by M. Zephirin Robert. After having been exhibited during the Exposition of 1867, in a store on the Boulevard des Filles du Calvaire, it was bought for the Museum of Saint-Germain. The case in which it is exhibited has been classified and labeled by M. Chantre who, in his work, gives a catalogue and full description. The value of the collection obtained from Larnaud, consists in this, that all the pieces which compose it are contemporaneous: there are 1485 such pieces, and the epoch to which they belong is evidently the end of the bronze age. This is what is shown by a comparison with those of the other foundries, and especially with the objects obtained from the palafittes of Savoy. Throughout, the last epoch of bronze is characterized by traces of the hammer, by the presence of metallic plates or leaves obtained by concussion and not merely by casting. On the other hand, that which links the workshop of Larnaud with the age when bronze was the only common metal are the cold chisels made of hard bronze to cut bronze, as steel cuts iron. But since bronze is softer than iron, can it be doubted that cold chisels would have been made of iron, if the latter metal had been known or was at least abundant? We will give further proofs showing more clearly the epoch to which we must refer the foundry of Larnaud.

There are other foundries belonging to this period, among which we will mention that of Poype, situated on the heights overlooking the Rhone to the South of Vienna. A portion of the bronze had been sold to a merchant of Lyons, at the price of old brass; it was bought by M. Chantre who, on precise indications, renewed the search and was able to duplicate the products. The foundry of Goncelin is also situated on the heights adjoining the Iser, as well as those of Thoduse and Bressieuse. The largest portion of the other stations of this kind are in the neighborhood of rivers, and probably at a short distance from the places then inhabited. What is probably the most remarkable is their uniformity throughout Europe. They indicate to all appearances, the passage or stay, long or short, of workmen belonging to the same class, but who were not natives. Foundries are, in fact, always found in isolated spots, but no traces of human habitations are seen. It is true that habitations may disappear, wooden houses crumble into dust, and the very stones become, in the course of time, dispersed and used elsewhere. There is, at any rate, one product of human industry which never disappears, and attests the presence of man during the most ancient times; that is the baked clay and especially broken pottery. Its tenacity is such, that on closely comparing the soil with some of the fragments, it is often easy to determine the place and size of cities which have disappeared several centuries ago. The neolithic foundries are never surrounded by such ruins.

There are but few lacustrial habitations where the metals were wrought, but here the natives might have been taught by travelers. The initiation seems, in fact, probable, from the existence of certain inhabited spots, which are called *stations*. Those which are known are not very extensive; in most cases they are

on a line with rivers, as may be seen, for example, on the banks of the Saone between Chalons and Tournus; still there are some isolated ones. The most important of them all is that of Saint-Pierre-en-Chastre in the forest of Compiegne. It is situated on the calcareous plateau in the swampy plains of Vieux-Moulin. It was dug by M. Viollet-le-Duc in 1860, and yielded, among other things, more than five hundred bronzes, which are indistinctly attributed to Gaelic armies. Since then, science having made some progress, they have found that it is necessary to distinguish the objects of stone, bronze, or iron obtained in that locality; that all was anterior to the time of Cæsar; that there were few arms; that the quality of bronze was identical to that of the other layers of that age throughout Europe. On close examination, comparisons showed that the stations of Saint-Pierre had probably existed for several centuries, and that it had witnessed if not the first appearance of bronze in that country, at least the epoch of that metal, and the commencement of the iron age.

But the interest in the stations is, in part, lost in that of the *tresors*, as these seem to demonstrate the reality of the traveling founders; the idea merely being suggested by the foundries. The most important were found in the Alps on the neck of the mountains, some near Moulins and Gannat, two in Meusth, and one near Sarrelouis; there are altogether twenty-nine in France, comprising upward of 1350 pieces.

These treasures are composed of new objects, never having been used; sometimes several are joined together, having been cast in the same mould.

They are found in small cavities expressly dug, where they seem to have been hidden for a short time by their possessors. These treasures, those of the Alps at least, are often found on high ground, not far from roads, frequented by travelers going from one country to another. There are no signs of a foundry in the vicinity, or even of a station, the spots where they were found are deserts. Is there anything to be found in these temporary deposits besides objects of traffic? Were they not hidden by the same men who, in the valleys, recast the inferior products of their own industry? If all this leads us to believe that such is the origin of the treasures, there would only have to be determined the direction in which these workmen went, to know whether they came from Italy to France, or vice-versa. It will directly be seen that this difficult problem is no longer insoluble to day.

The treasure of Reallon, which is now in the museum of Saint-Germain, was found in that village not far from Embrun 3880 meters high. "This road, anciently frequented by foot-travelers, leads from Saint Bonnet to Embrun, by Gociere." The treasure of Beauviears was found by a farmer. This village of the arrondissement of Die is situated on an ancient passage of the mountains, on the peak of Calre, on the road to Luc. There were many other valuables which had been stowed away on the upper banks of rivers, as well as on the plains. —*Van Nostrand's Magazine.*

PRE-HISTORIC MOUNDS IN KANSAS.

On a high bluff, about six miles west of town, near the residence of Mr. J. B. Stuart, on the Smoky Hill, stands an ancient mound, which was first noticed last September by Mr. George Wiseheart, of Illinois, while visiting in the family of Mr. Stuart. Mr. Wiseheart made some slight excavations into the mound, and, upon finding some remains of human bones, he reported the fact in town, which led some gentlemen to determine to explore it still further.

Accordingly, on Thursday, November 28th, a party visited the place, and there found the mound to be a very prominent object on the hill, and composed of stones, large and small, filled out with earth. The stones have all been brought to the spot and deposited by human hands, as no rock exists in its immediate vicinity. The whole work is about twenty-five feet in diameter, and is maniform in shape. There has been no attempt at anything like masonry in its structure, but the stones are arranged in curious, irregular circles, the inner one at the top of the mound being about six feet in diameter, surrounded by others of similar size, and still others smaller. There are numerous others of these circles made all around the mound, on every side, but more numerous on the south and southeast sides. They vary greatly in dimensions, but are all of the same general appearance, and cover quite a large extent of surface.

From the appearance of these circles within circles, it was thought that the mound might originally have been pyramidal, but the wear and tear of ages and rains and tempests have reduced it to its present form.

Upon digging into the tumulus many of the stones were found arranged into rude arches, but this was not general as far as explored.

Quite a quantity of bones and teeth were found, some human, some of large animals, and some belonging to rodents, but all were in such a decayed and fragmentary condition that it was not possible always to distinguish them particularly. Several small pieces of human skull were there, but none large enough to discover the race of the individuals. Some of the animal bones have evidently been subjected to the action of fire, and pieces of burnt clay or brick also indicated the presence of fire, though not a particle of charcoal was seen.

It was impossible to distinguish the manner in which the dead were buried, whether lying or sitting or doubled up, or in which direction the head or heads lay, as the bones were mingled indiscriminately in the most confused manner, a piece of skull lying in juxtaposition to a toe or hip bone, with the tooth of an unguiculate animal or the jaw of a small rodent close by.

No weapons or implements either of stone or bone were found, except some fragments of pottery, and these very small and composed of a peculiar black silicious clay, and some small tubes of bone, ornamented on the outside with spiral cuttings of a knife, and one little bone button.

Who built this tumulus? Some mounds in the United States have been assigned an age of two thousand years, and we have no doubt, judging from the st te of decay of its contents, that this one is among the oldest.

For what purpose it was built is another interesting question. It is on the top of a high hill, and no alteration in the face of nature could ever have driven a brook or other stream from its vicinity. Water is too far away to allow the supposition that it ever was a permanent dwelling place.

The bluff on which this relic stands, although it has a very steep and abrupt south face, has a gradual and long slope towards the east. The mound does not stand on the summit of the hill, but a little way down this eastern slope, and this with the peculiar little irregular circles of stone, with the charred bones of animals and the presence of fire, seem to make the most probable conjecture as to its origin to have been on some great sacrificial occasion, following the death of some great chieftain or renowned man, when all the people assembled for a period of mourning for the great or loved departed; looking to the east as the source of light and the hope of the tribe that the darkness of the tomb might thence in the distant future be illumined.—*Junction City Union, Dec. 7.*

CHEMISTRY.

LOCKYER ON THE NATURE OF THE ELEMENTS.

At a crowded meeting, such as is seldom witnessed, of the Royal Society on Thursday evening last, Mr. J. Norman Lockyer, F. R. S., read a lengthy paper, in which he discussed the evidence derived from spectroscopic observation of the sun and stars and from laboratory experiments, which has led him to the conclusion that the so-called elements of the chemist are in reality compound bodies. In order that the line of argument followed by Mr. Lockyer may be understood, it will be necessary briefly to refer to the results of previous researches. As a rule, in observing spectra, the substance to be examined is volatilized in a gas flame or by means of sparks from an induction coil, and the light is allowed to fall on the slit of the spectroscope; the spectrum is then generally one in which the lines run across the entire field, but by interposing a lens between the spark apparatus and the slit of the spectroscope, Mr. Lockyer was enabled to study the various regions of the heated vapor, and thus to establish the fact, already noted by some previous observers, but to which little attention had been paid, that all the lines in the spectrum of the substance volatilized did not extend to equal distances from the poles. He then showed by the aid of this method that in the case of alloys containing different proportions of two metals, if the one constituent were present in very small quantity its spectrum was reduced to its simplest form, the line or lines longest in the spectrum of the pure substances alone appearing, but that on increasing the amount of this constituent its other lines gradually appeared in the order of their lengths in the spectrum of the pure substance. Similar observations were made with compound bodies. It was also

noticed that the lines furnished by a particular substance varied, not only in length and number, but also in brightness and thickness according to the relative amount present. Armed with these facts, and with the object of ultimately ascertaining more definitely than has hitherto been possible which of the elements are present in the sun, Mr. Lockyer about four years ago commenced the preparation of a map of a particular region of the spectra of the metallic elements for comparison with the map of the same region of the solar spectrum. For this purpose about 2,000 photographs of spectra of all the various metallic elements have been taken, and, in addition, more than 100,000 eye observations have been made. As it is almost impossible to obtain pure substances, the photographs have been carefully compared in order to eliminate the lines due to impurities; the absence of a particular element as impurity being regarded as proved if its longest and strongest line was absent from the photograph of the element under examination. The result of all this labor, Mr. Lockyer states, is to show that the hypothesis that identical lines in different spectra are due to impurities is not sufficient, for he finds short line coincidences between the spectra of many metals in which the freedom from mutual impurity has been demonstrated by the absence of the longest lines. He then adds that five years ago he pointed out that there are many facts and many trains of thought suggested by solar and stellar physics which point to another hypothesis—namely, that the elements themselves, or, at all events, some of them, are compound bodies. Thus it would appear that the hotter a star the more simple its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines and a few very thin metallic lines, characteristic of elements of low atomic weight; while the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and the coolest stars furnish fluted band spectra characteristic of compounds of metallic with non-metallic elements and of non-metallic elements. These facts appear to meet with a simple explanation if it be supposed that as the temperature increases the compounds are first broken up into their constituent "elements," and that these "elements" then undergo dissociation or decomposition into "elements" of lower atomic weight. Mr. Lockyer next considers what will be the difference in the spectroscopic phenomena, supposing that A considers B as an impurity and as a constituent. In both cases A will have a spectrum of his own. B, however, if present as an impurity, will merely add its lines according to the amount present, as we have above explained; whereas if a constituent of A, it will add its lines according to the extent to which A is decomposed and B is set at liberty. So that as the temperature increases the spectrum of A will fade if A be a compound body, whereas it will not fade if A be a true element. Moreover, if A be a compound body, the longest lines at one temperature will not be the longest at another. The paper chiefly deals with a discussion from this point of view of the spectra of calcium, iron, hydrogen, and lithium as observed at various temperatures; and it is shown that precisely the kind of change which is to be expected on the hypoth-

esis of the non-elementary character of the elements has been found to take place. Thus each of the salts of calcium, so long as the temperature is below a certain point, has a definite spectrum of its own, but as the temperature is raised the spectrum of the salt gradually dies out, and very fine lines due to the metal appear in the blue and violet portions of the spectrum. At the temperature of the electric arc the line in the blue is of great intensity, the violet H and K lines, as they are called, being still thin; in the sun the H and K lines are very thick, and the line in the blue is of less intensity than either, and much thinner than in the arc. Lastly, Dr. Huggins's magnificent star photographs show that both the H and K lines are present in the spectrum of *a* Aquilæ, the latter being, however, only about half the breadth of the former; but that in the spectrum of *a* Lyræ and Sirius only the H line of calcium is present. Similar evidence that these different lines may represent different substances appears to be afforded by Professor Young's spectroscopic observations of solar storms, he having seen the H line injected into the chromosphere 75 times, the K line 50 times; but the blue line, which is the all-important line of calcium at the arc-temperature, was only injected thrice. In the spectrum of iron, two sets of three lines occur in the region between H and G which are highly characteristic of this metal. On comparing photographs of the solar spectrum and of the spark taken between poles of iron, the relative intensity of these triplets is seen to be absolutely reversed; the lines barely visible in the spark photograph being among the most prominent in that of the solar spectrum, while the triplet, which is prominent in the spark photograph, is represented by lines not half so thick in the solar spectrum. Professor Young has observed during solar storms two very faint lines in the iron spectrum near G injected 30 times into the chromosphere, while one of the lines of the triplet was only injected twice. These facts, Mr. Lockyer contends, at once met with a simple explanation if it be admitted that the lines are produced by the vibration of several distinct molecules.

The lithium spectrum exhibits a series of changes with a rise of temperature precisely analagous to those observed in the case of calcium.

In discussing the hydrogen spectrum, Mr. Lockyer adduces a number of most important and interesting facts and speculations. It is pointed out that the most refrangible line of hydrogen in the solar spectrum, *h*, is only seen in laboratory experiments when a very high temperature is employed; and that it was absent from the solar protuberances during the eclipse of 1875, although the other lines of hydrogen were photographed. This line, also, is coincident with the strongest line of indium as already recorded by Thalen, and may be photographed by volatilizing indium in the electric arc, whereas palladium charged with hydrogen furnishes a photograph in which none of the hydrogen lines are visible. By employing a very feeble spark at a very low pressure the F line of hydrogen in the green is obtained without the blue and red lines which are seen when a stronger spark is used, so that alterations undoubtedly take place in the spectrum of hydrogen similar to those observed in the case of calcium. In concluding this portion of his paper, Mr. Lockyer states that he has obtained evidence

leading to the conclusion that the substance giving the non-reversed line in the chromosphere, which has been termed *helium*, and not previously identified with any known form of matter, and also the substance giving the 1474 or coronal line, are really other forms of hydrogen, the one more simple than that which gives the *h* line alone, the other more complex than that which gives the F line alone.

There can be no question that the facts brought forward by Mr. Lockyer are of the highest importance and value, and that they will have much influence on the further development of spectrum analysis, to which he has already so largely contributed. But his arguments are of a character so totally different from those ordinarily dealt with by chemists that they will hesitate for the present to regard them as proof of the decomposition of the elements until either they are assured by competent physicists that they cannot be explained by any other equally simple and probable hypothesis, or until what Mr. Lockyer has foreshadowed as taking place to such an extent in other worlds has been realized beyond question or cavil in our own laboratories. It has been suggested that the same molecule may be capable of vibrating in different ways at different temperatures, and thus of yielding different spectra, just as a bell may give out different notes when struck in different ways; and although Mr. Lockyer has replied to this objection, it can scarcely be regarded as finally disposed of. The fact, however, as Mr. Lockyer has pointed out, that the change from the spectrum of a compound to the lowest temperature spectrum of a metallic element is of a similar character to and even less in degree than the change from the lowest temperature spectrum of the metal to the spectra which it furnishes at higher temperatures does not appear to favor such an hypothesis, and from the similarity in the phenomena it is difficult to deny that in both cases decomposition does not equally take place. Prof. Young's observations on the injection of particular lines into the chromosphere during solar storms are also difficult to reconcile with this view, and if the conclusions drawn from previous researches are correct, it also does not account for the short line coincidences which led Mr. Lockyer to his hypothesis.

Chemists are careful to teach that what are at present regarded as elements are not necessarily simple bodies, but merely substances which they are unable to decompose or which they have no special reason to regard as compound bodies. The remarkable relations, both in atomic weight and properties, existing between many of the elements, tend, indeed, to show that they are related in the manner Mr. Lockyer supposes. We sincerely hope that he will continue his researches in this direction, and we trust that at no very distant time he may be able to bring forward evidence sufficiently clear to convince even the most skeptical.—*Chemical News, Dec. 20.—From London Times.*

METEOROLOGY.

MEMORABLY COLD WINTERS.

COMPILED BY THE EDITOR.

The severity of the present winter having been regarded as in a high degree remarkable by many, it has occurred to the writer that a brief compilation from various sources, embracing an account of unusually cold winters at various times and places might prove of decided interest to the general reader. For this purpose alone the following paragraphs have been thrown together:

Dr. Kane, while wintering in Smith's Sound, (78° 37′ North latitude) in the winter of 1853, probably experienced the most intense cold ever felt by man. He says of it: "On the 17th of January our thermometers stood at –49°, and on the 20th the range of those at the observatory was –64° to –67°.

On the 5th of February our thermometers began to show unexampled temperature. They ranged from –60° to –75°, and one very reliable instrument stood upon the taffrail of our brig at –65°. The reduced mean of our best spirit-standards gave –67°, or –99° below the freezing point of water.

At these temperatures chloric ether became solid, and carefully prepared chloroform exhibited a granular pellicle on its surface. The exhalations from the surface of the body invested the exposed or partially clad part with a wreath of vapor. The air had a perceptible pungency upon inspiration, and when breathed for any length of time it imparted a sense of dullness to the air-passages."

The lowest temperature recorded by any of Dr. Kane's thermometers, was –80°, afterwards corrected with ten other bulb instruments and reduced to a mean of –68° or 100° below freezing point of water. On the 7th of January 1855, the reduced mean of the lowest temperature was –69.3.

Dr. Hartwig says: "About the same time, (Feb. 9th and 10, 1854) Sir E. Belcher experienced a cold of –55° in Wellington Channel, (75° 41′ N.) and the still lower temperature of –62° on January 13th, 1853 in Northumberland Sound, (76° 52′ N.). Whymper, on December 6th, 1866, experienced –58° at Anatto, Alaska, (64° 42′ N.)."

Capt. Howgate, in his interesting article in the *North American Review*, on "The Cruise of the Florence," says, that the coldest day experienced by her navigators, was in Annanatook Harbor, January 21st, 1878, when the mercury fell to –52°.

In Portland, Maine, the mercury reached its minimum point in the winter of 1856 at –18°; in Boston, at –13°; in Albany, at –25°; in Pittsburg, at –12°; in St. Paul, at –35°; in Ft. Laramie, at –14°; in Ft. Kearney, at –12°; in Leavenworth, at –20°; in Cincinnati, at –11°, and in St. Louis, at –5°.

The Kansas City *Journal* quotes from its old files:

"On the night of the 24th of December, 1855, the Missouri River at this place was frozen over. It is now near five weeks that the river has been a highway for teams of horses, mules and oxen. We put this fact on record for coming years. We have now had near seven weeks of hard freezing weather. A fact unparalleled in the history of this country; People will hereafter refer to the long cold winter of 1855–56. The Indians say it is the severest known for a quarter of a century, nothing like it being seen by the present generation." And under date of Saturday, February 2d, 1856; "The cold weather of the past few weeks has been general. From every part of America—from Halifax to Cuba we have accounts—and it is everywhere spoken of as the coldest ever known. At Memphis the citizens are putting up their own ice, a circumstance unknown before. The floating ice has reached the mouth of the Mississippi— a fact unheard of even to tradition. The Brazos River in Texas is frozen sufficiently hard for the crossing of teams. In Cuba they have a real Northern winter. At St. Paul, Minnesota, the thermometer has been 41 degrees below zero."

And again on February 9th, one week later still. "The cold weather continues unabated. On Sunday and Monday (3d and 4th) the thermometer stood 28 and 30 degrees below zero. We have been looking for Dr. Kane for the last four weeks."

And finally March 1st. "The river at this place broke up on Monday morning last, the 25th of February, 1856—having been closed *sixty-two* days. The shore is piled with broken ice at the present writing, but the channel is almost entirely clear. We have no advices from above and cannot say how far it is open. To-day (Friday) it is snowing heavily, the ground being completely covered."

The coldest days within twelve years in this city have been February 6th, 1872, when the thermometer marked $-12°$ at 7 a. m.; December 24th, 1872, $-16°$ at 7 a. m.; January 20th, 1873, $-21°$ at 7 a. m.; January 16th, 1877, $-12°$; December 16th, 1878, $-16°$ at 7 a. m.

The present winter has been a phenomenal one in the United States, by reason of universal snow storms and cold weather. The severity of the latter is attested by the records of the Signal Service Corps. On January 2d, at 3:42 p. m., the thermometers at the various signal stations marked as follows:

Chicago, Ill., $-9°$; Davenport, Iowa, $-14°$; Indianapolis, Ind., $-4°$; La-Crosse Wis., $-10°$; Leavenworth, Kas., $-3°$; Omaha, Neb., $-5°$; St. Louis, Mo., $-1°$; St. Paul, Minn., $-8°$; Yankton, D. T., $-16°$, while the snow varied in depth at the same stations, from six inches to two feet.

For the extremes of cold reached in former times we have no authority at hand more ancient than Horace, who thus records the weather in Rome along about the year 25 B. C.

> "Vides ut alta stet nive candidum
> Soracte, nec jam sustineant onus
> Silvæ laborantes geluque
> Flumina constiterint acuto."

Flammarion, in his work on The Atmosphere, devotes a chapter to a description of the extremely cold winters within one hundred years prior to 1872. In 1776 the Tiber, the Rhine, the Seine and even the Rhone, rapid as it is, were nearly entirely frozen over. The winter of 1788–9, the precursor of the French Revolution, was one of the longest and most severe winters that ever prevailed in Europe. In Paris the cold commenced on November 25th and lasted fifty consecutive days, commencing to thaw January 13th, when the snow was found to be twenty-six inches thick. In the great canal at Versailles the ice was two feet thick. Water froze in very deep wells and wine became congealed in cellars. The mercury at Paris on the 31st of December, was –7.2°

The cold was equally severe elsewhere. At Lyons and at Toulouse the Rhone and the Garonne were frozen over, and even the sea itself for several leagues off the Atlantic coast. The Rhine was crossed with loaded wagons and the Elbe with heavy carts. People rode on horseback over the harbor at Ostend, and during the Christmas holidays the Thames, in the neighborhood of London, was covered with shops. In Toulouse the very bread was laid before the fire to be warmed and then broken with a hatchet; in Galicia, near the end of December, thirty-seven persons were found dead in three days, and the very fish perished in the ponds in France. In Bâle, in Switzerland, the thermometer marked –35°; at Warsaw, in Poland, –26°; at Dresden, –25°; at St. Petersburg, –23°; at Strasbourg, –45°; at Tours, –13°, and at Marseilles the lowest point reached was on the 31st of December, when the mercury stood at –1.4° Fahrenheit. The winter of 1794–75 was also very severe, the mercury sinking at Paris, on the 25th of January to –10.11°, being the coldest day ever known there. Pichegru, then in Holland, sent a detachment of cavalry across the Texel wlth orders to capture the vessels of the enemy caught at anchor in the ice. During that of 1798–99 the Meuse, the Elbe, the Rhine and the Seine were frozen over, and a regiment of dragoons, starting from Meyence, crossed the Rhine upon the ice instead of at the bridge at Cassel, which had been removed. The lowest temperature marked, was 0.3°, December 10th 1798.

The winter of 1812–13 will ever be remembered in history. It witnessed the retreat of the French army from Russia amid all the horrors that succeeded the capture and the conflagration of Mosoow. The retreat began on the 18th of November, and was complete on the 23d. On the march to Smolensk the snow fell almost without ceasing. On the 17th the temperature fell to –15°02 according to Baron Larry, and some of the Russian artillery crossed the Dwina upon the ice. From the 26th to the 29th, during the crossing of the Berezina, the river was choked with blocks of ice loosened by the thaw, which began on the 24th. The severity of the weather was soon as great as ever, and on the 30th of December, the mercury fell to –13°; on December 3d, to –22°, and on the 6th of December, the mercury stood at –35°.

In January, 1820, at St. Petersburg, a temperature of –25.6° was recorded, –11.9° at Berlin, and in France several travelers, farmers and game-keepers were frozen to death. The winter of 1829-30 was also a very cold one. In St.

Petersburg the mercury sunk to $-26°$; at Nancy, to $-15.3°$; at Strasbourg to $-10.1°$, and at Metz, to $-4.9°$. In Paris the lowest point was $-1°$. In Switzerland the cold was very severe in the great altitudes. In Yverdun in the plains the thermometer fell in a few hours, from 14° above, to $-4°$, and polar snow, the crystalization of which is very close and which is peculiar to very low temperatures, was observed. The Seine was frozen over from the 28th of December to the 26th of January, and afterward from February 5th to the 10th, making thirty-four days in all. On the 25th of January, after a thaw, the ice from Corbeil and Melun blocked up the bridge at Choisy, forming a wall sixteen and a half feet high. On the 15th of December, 1840, the ashes of Napoleon, brought home from St. Helena, entered Paris under the Arc de Triomphe, and Flammarion says:

"The thermometer exposed to nocturnal radiation had that day marked $-6.8°$, Fahrenheit. An immense crowd, the National Guard of Paris and its suburbs, and numerous regiments, lined the Camp Elysees from the early morning till two in the afternoon. * * * Soldiers and workmen, hoping to obtain warmth by drinking brandy, were overpowered by the cold and dropped down dead of congestion. Several persons perished, victims of their curiosity; having climbed up into the trees to see the procession, their extremities, benumbed by the cold, failed to support them, and they were killed by the fall.

January 2d, the thermometer at the observatory at Mont St. Bernard marked $-9.9°$. The winters of 1853–4 and 1854–5 were also very rigorous, especially in Southern Russia, Denmark, England and France. The Rhone, the Saone and the Rhine were all frozen over, and in January, 1858, the Danube and even the Russian ports in the Black Sea. The winter of 1854–5 was more severe. The mercury reached $-19.8°$ at St. Petersburg and $-14.4°$ at Riga. The Seine was frozen over at Paris and people crossed it.

The winter of 1870 and 1871 is also memorable in the history of warfare, and from the fatal influence of the cold upon the health of the combatants. Many of the outposts around Paris and several of the wounded were found frozen to death on the field. The winter average there was nearly $-3°$ lower than usual, and M. Renou observed $-9.4°$at Perigueux and $-13°$ at Moulins. Flammarion sums up the results of a number of tables of low temperature with the following statement:

The greatest cold yet experienced has been $-24°$ in France; $-5°$ in England; $-2°$ in Holland and Belgium; $-67°$ degrees in Denmark, Sweden and Norway; $-46°$ in Russia; $-32°$ in Germany; 0° in Italy; $-10°$ in Spain and Portugal. * * In non-European countries it is certain that at Fort Reliance, in British North America, there have been $-70°$ of cold, and at Semipalatinsk $-76°$.

M. Renou has noticed that the severest winters seem to recur about every 40 years: 1709; 1749; 1780; 1830; 1870.

A REVIEW OF THE WEATHER CONDITIONS OF THE FIRST WEEK OF THE YEAR 1879.

BY ISAAC P. NOYES, WASHINGTON, D. C.

It is seldom that we have two such opposite and positive conditions come so near together as passed over the country the first few days of the new year. The first was a severe cold wave from the west that affected all that portion of the country east of the Rocky Mountains; the second, immediately following it, was a warm wave following the same general course. A few years since we could not have satisfactorily explained this, but by the facts accumulated by the Signal Office we are now able to make the whole phenomenon so plain "that even those who run may read" and understand. Without going too deep into the science of the matter, the cause of these changes in the weather is what is known as low barometer, which *draws* the currents of air towards it with more or less force from all directions, and the force depends upon the singleness, positiveness, and concentration of this center of *low*. When there is only a single *low* the effect—other things being equal—will be more powerful than where there are two or more centers to divert the force.

In these late "conditions" the theory herein advanced corresponds, both *before* and *after*, with the facts gathered from the map published by the Signal Office. These facts can be readily understood by those who have a knowledge of common physics, and with this knowledge they may readily comprehend such a storm. The center of low barometer may start anywhere, but when once started travels in a *general* easterly direction—the same as the Mississippi River courses to the south, though we know that there are local points where it courses even to the north. The first low started in the southwest—in Texas. At least here is where we first took it up. We have no stations south of the Rio Grande, yet it would be well if we had—it would be a great addition to the weather service. This *low* travelled towards the northeast for a short distance, that is, the center of it did, but as a whole, after going northeast, it took a more easterly direction to the Atlantic Ocean. We were not able to trace it beyond the boundary of the ocean. Here is a barrier that we cannot at present pass, though we may hope to some day. But from our knowledge of the manner in which the wind travels we can trace up the center of *low* with as much certainty as a well-trained Indian follows a trail. This cold storm, upon which pages might be written, was the result of a single, positive and concentrated area of low barometer traveling in its regular course towards the east. This is the only view that the facts gathered by the Weather Bureau will support, and it is at once reasonable and satisfactory, as the sudden change of the 7th and 8th of January, in the same portion of the United States, will conclusively prove. Mild weather with southerly winds followed this cold blast from the west. Why? is the question. The facts on which this article is based will readily demonstrate why, and that is more than any other known theory will do, and for this if for nothing more it should be accepted,

even if not as the whole truth, as the most true revelation yet known to man to explain the weather problem. The simple cause of this great change is that in this second case *low* barometer started in the northwest and traveled on nearly a straight line east. Traveling on a higher line of latitude it caused the wind in the United States west of the Rocky Mountains to be from the warm sections of the south.

Recently it has been advanced by some one that "according to the latest view of the weather the cold attending these great waves which roll over the country does not come from a distance, but from overhead." The person who promulgated this idea did not seem to think when writing it what his words here imply. If these cold waves come from overhead they may come from even a greater distance than the theory above referred to could reckon. For "overhead" implies more millions of miles than we can conceive of. Of course, all know that above the earth a short distance the air is intensely cold. Those who hold to these views of the weather neither ignore this nor have need to speak of it. We must necessarily deal with the air of our globe as we find it near the surface of the earth—in the stratum that supports life. There is no *chance or unknown disturbance* that creates these effects. They are as well known as any physical facts in any well-known department of knowledge, and to explain them there is no need mysteriously to call on "electricity" or "disturbances of equilibriums," etc. Such terms may sound very nice, but they are meaningless when used in this blind connection. They answered very well when we were in darkness as to the whole subject, but in the light of the present knowledge they are mere foolishness. Our globe rolls through space, and of course we must be affected by the atmosphere that surrounds us, but as our great waters remain with us and form a part of us so does our atmosphere—the atmosphere that supports us in life. It remains with us, no matter how much it may mix and intermix with the ether beyond. It forms a mass by itself, and this mass obeys certain known laws that are now well recorded in the weather maps of the day.

To sum up the changes in the weather, they are caused by the winds being *drawn* toward the center of low barometer. This center of low barometer is ever changing, although its full changes we are not familiar with, for the barrier that the expanse of oceans presents prevents us. *Low* always travels in an easterly direction. If the earth turned on its axis toward the west the direction would be reversed. If low barometer travels on a high line of latitude it will cause it to be warm south of that line. If on a low line it will cause it to be cold north of that line. Cold winds come from the north, warm winds from the south, and as winds partake of these two elements they will be either cold or warm. In a short article like this, one cannot be as explicit as he would like to be. There are many influences ever at work that cause changes in our weather system, and that make even similar conditions so vary in detail or at different times as to produce quite different results. These two conditions, however, that passed so near in line to each other and that yet were so different in their effects, afforded a fine study and a fine test of the system that is at present followed with so much

satisfaction. It is, however, comparatively a new subject, and it remains yet to have volumes written upon it; but no matter how many volumes are written upon it, those who are most familiar with the subject as revealed in the weather maps that are daily published, feel confident that additional knowledge will support rather than refute the ideas herein set forth.

BOOK NOTICES.

GEOLOGIST'S TRAVELING HAND-BOOK AND GEOLOGICAL RAILWAY GUIDE, by James MacFarlane, New York; D. Appleton & Co., 1878-9. 216 pp. $1.50.

This neat little book is, as it states, a complete railway guide of the United States and Canada, with notes of the geology opposite each station. It is convenient and handy for the tourist. It is a condensed compendium of the geology of the whole United States through or near where any railroad passes.

Its author, James MacFarlane, is also the author of a valuable work on The Coal Regions of America, already passed through several editions. The present work is the result of his own accurate observation and the co-work of the various State Geologists and other scientific gentlemen of the United States, and should be in the hands of all geologists. In a condensed form it contains the latest correct geological information of our country. We have here nearly fifty pages of introductory remarks descriptive of the various formations known in the United States, arranged according to Dana's latest tables. These descriptions are short, clear and instructive.

In this book we find an interesting contribution from T. Sterry Hunt on the eozoic (archaian azoic). Mr. Hunt has probably studied these ancient rocks more closely than any other person, and for more detailed descriptions we would refer to his valuable work "Geological Essays," but here we have the result of his latest studies in a very few pages, of which the following is an abstract:

These rocks he describes beginning with the oldest, and names them 1 (a) Laurentian, 1 (b) Norian, 1 (c) Huronian, 1 (d) Montalban.

(1 a) The *Laurentian* is a strong, massive gneiss, reddish or grayish in color, sparingly micaceous, but often hornblendic. The gneisses are for the most part distinctly stratified, but occasionally the evidence of stratification is not very apparent, so they are often denominated granites. (Mr. Hunt only applies the name granite to a species of eruptive rocks—to similar metamorphic rocks he seems always to apply the term gneiss.) The series is distinguished by the absence of chloritic, talcose, argillaceous or micaceous schists, but includes crystalline limestones, of which there are supposed to be more than 1,000 feet of thickness on the Ottawa. Great masses of magnetic iron are inter-stratified, and we also have graphite. These rocks form the Laurentide Mountains of Canada, Adirondacks

of New York, Highlands of the Hudson, Gneiss (granite) of Richmond, Va., Roan Mountain of North Carolina, Gneisses of Western Islands of Scotland, of Scandinavia and Finland, and of some of the Alps. In this formation occurs the strange foraminiferal organism called Eozoon Canadense—the first evidence of organic life.

(1 b) To the *Norian* Dr. Hunt refers the upper portion of the Laurentian on the Ottawa, made up of labradorite or related anorthic feldspar, with some true gneisses and crystalline limestone. A similar terrene occurs in Norway, also resting unconformably on the older Laurentian, to which the name of Norete has been applied. Red garnet, green epidote, biolite and ilmenite are often present. Great beds of titaniferous iron abound in the Norian series. This terrene covers several hundred square miles in Essex county, New York, where it rests unconformably upon the Laurentian. An extensive area also exists on the coast of Labrador.

(1 c) *Huronian.* These are found on the north shore of Lake Superior, part of the Huron Mountains south of Lake Superior, some rocks of Newfoundland, part of Green Mountain series and southwestwardly along the Blue Ridge, northeast of Bay of Fundy, along the coast of Maine, Massachusetts and Rhode Island. They are everywhere highly disturbed and are many thousand feet thick. They are chiefly porphyries or petrosilex rocks or dionrites which are often chloritic Steatites and dark-colored serpentines abound in parts of the series. They contain the specular and magnetic iron ores of northern Michigan and similar ores in southeast Missouri. A series of rocks which Dr. Hunt has referred to the Huronian appears in parts of the British islands, viz.: In Donegal, Ireland, in Auglesea, in Caernarvonshire. Rocks underlying the Lower Cambrian in South Wales, to which the name of Dimetian has lately been given, seem also to belong to the Huronian. The gold-bearing rocks of California belong both in these crys alline schists and in the eruptive granites.

(1 d) *Montalban.* These rocks are said by Dr. Hunt to be lithologically and geognostically distinguished from the Huronian, and are well displayed in the White Mountains of New Hampshire, hence the name. They occupy large areas in New England, and constitute the gneisses and mica schists of New York Island, of Philadelphia, Baltimore and Washington, and at the summit of the Huronian in Northern Michigan. In Virginia and North Carolina they are gold-bearing. These gneisses are distinguished from those of the Laurentian by being finer grained and having white feldspar. Hornblende prevails, and the gneiss passes into a bluish black hornblende rock. The mica schists are remarkable for the abundance of crystallized garnet, stanolite, chiastolite and cyanite.

The only serious error I find in this work is one in which the author says that lead at Granby and Joplin occurs in sandstone of the age of millstone grit. To be sure, in the valleys are found masses of sandstone—also on the hill-tops, but the hills on which lead and zinc are found are essentially of limestone with much chert, carrying fossils of the age of the Keokuk group, but on higher ground some fossils present types of the Chester group. G. C. Broadhead.

Eden Dell or Love's Wanderings, and Other Poems, by George W. Warder, Kansas City, Mo.; Ramsey, Millet & Hudson, 1878. pp. 358. 12 mo.

This volume is mainly a tribute of affection to the memory of a deceased wife, and as such must necessarily be regarded kindly. We find in it many excellent things, many passages showing that the author is possessed of fine imaginative powers, genuine poetic fancies, and an education commensurate with the demands of the work he has undertaken. Faults the work certainly has, but it is evident that they are due in a great degree to haste in composition and the preparation of the book, and will be corrected in a second edition, which we hope will soon be called for.

The printing and binding reflect great credit upon the taste of both author and publishers.

Evolution of Sound, by Wilford, Hall & Co., New York, 1878. Octavo, paper. pp. 260.

This is part of a work by an anonymous writer, called The Problem of Human Life, Here and Hereafter, in which the wave theory of sound is assailed and a new hypothesis proposed, i e., that of substantial, sonorous corpuscles. In this day of surprises, when Lockyer announces that the chemical elements are compound in their nature, and hydrogen the basis or starting point of everything; when Professor Crookes demonstrates that matter exists in four states or conditions instead of three, as heretofore believed; and Tyndall reasons out the deduction that there is no God, but that every step in the phenomena of life can be accounted for without invoking the supernatural, we are prepared for any innovation whatever, and are not prepared to reject any hypothesis in natural science no matter how startling and reversive of accepted teachings. The author of the volume under consideration starts with the hypothesis that sound must be a substantial entity, consisting of corpuscular emissions or some kind of atomic emanations, and shortly formulates the law governing the generation of sound or tone in these words: "It is not the mechanical effect of the numerous short motions back and forth upon the surrounding air which generates the tone of the fork or string, but it is the molecular effect of the sudden stops and starts on the atomic structure of the instrument itself, causing thereby the emission of the substantial pulses we call sound."

The writer proceeds to prove this law by showing the apparent fallacy of the wave theory as taught by Tyndall and Helmholtz, and by several illustrations which he claims explain all the phenomena of sound on his basis alone. He sets forth, among other arguments, that if the wave theory is correct a locust must exert millions of tons of mechanical force by the motion of its legs, and claims that the experiments of the United States Signal Corps with sirens and fog-horns prove conclusively that sound is a substance, which can push through the resistance offered by the highest adverse winds.

The line of argument is bold and aggressive, and, at the same time, ingenious, and the illustrations forcible, and while in the light of present theories, sup-

ported by experiments with the newly-invented phoneidoscope, not prepared to admit the conclusions without further examination, we can candidly say that it is a work deserving careful study and consideration. S.

Atti Della Societa Toscana di Scienze Naturali. Vol. III. Fasc. 1. Pisa, 1877. pp. 200. Large octavo.

We have received the above-named report from Prof. Antonio D'Achiardi, Secretary, and find it a fine specimen of the printer's art. It is also beautifully illustrated with lithographic plates of excellent workmanship. We hope to find among our scientific friends some one who is capable of giving this report an intelligent perusal and a critical review of it for a future number of the Review.

SCIENTIFIC MISCELLANY.

THE FOURTH STATE OF MATTER.

Another sensation has lately been created in scientific circles by the announcement that Professor Crookes, of London, has discovered a fourth state or condition of matter in addition to those of fluidity, solidity and gaseity, hitherto regarded as comprehending all of its phases. The modern theory of the gaseous state is based upon the supposition that a given space contains millions upon millions of molecules in rapid movement in all directions, each having millions of encounters in a second, both the rapid movements and the contacts being necessary conditions of the gaseous state.

The Professor's line of argument is, that setting up an intense molecular vibration in a disk of metal by electrical means excites a molecular disturbance which affects the surface of the disk and the surrounding gas. The diameter of the dark space which appears round the negative pole of an ordinary vacuum tube when the spark from an induction coil is passed through it, varies with the degree of the exhaustion of the gas in the tube, but not with the distance separating the magnetic poles, nor with the alteration of battery power or intensity of spark; the form remains unchanged without regard to the intensity of the brilliancy of the spark. Hence he concludes that the layer of molecular disturbance thus made visible is identical with the invisible layer of molecular pressure, and afterward by experiments of various kinds he essays to establish the fact that these molecules whose impact upon the sides of the glass tube occasions evolution of light are sensitive to magnetic influence, and that the amount of deflection in the current or stream of light depends upon the amount of magnetic power employed, thus modifying the well-known law of the directness of the rays of light.

The whole theory depends upon a degree of rarefaction of the gas or air in

the tube which never can be experienced in reality, and without which this fourth state of matter cannot exist, since its peculiarity consists merely in the reduction of the number of molecules in the tube by rarefaction or exhaustion of the air, or gas therein, until the properties which constitute the ordinary gaseous state, which depend upon constant collisions among the molecules, are reduced to a minimum and the matter becomes exalted to an ultra-gaseous state, in which the corpuscular condition of light may be detected, and in which light does not always move in a straight line. These phenomena, Prof. Crookes concludes, in these exhausted tubes we can never experience, but must be content to observe and experiment with from the outside. In brief, it seems to be the Professor's idea that air or gas may be so attenuated in a vacuum tube that by means of magnetism light may be rendered visible in a bodily form, and may be diverted by the same means from a straight line, and also that its attenuation may be so extreme, or, in other words, its molecules or particles so reduced in number or quantity, that there will not be enough of them left to furnish the conditions of gaseity, and consequently the fourth state, that of the ultra-gaseous, will be present.

GARY'S MAGNETIC MOTOR.

It is only necessary to mention something new in mechanics speedily to raise a mushroom crop of the original inventors of that very idea. Thus the announcement of Miss Hosmer's alleged discovery of a magnetic motor has brought forth various claimants to a like invention. None of them, however, are as specific in description of their new motor as Wesley W. Gary, of Boston. Mr. Gary's invention rests first on the discovery of a neutral line in the magnetic field of a permanent or common horseshoe magnet, in front and on either side of the two poles at a distance therefrom proportionate to the size and strength of the magnet, and the thickness of the armature brought into the field to be affected by magnetic action. This neutral line may be said to be the place where the polarity of the magnetic forces, under the given circumstances, is balanced, so that the armature, or any piece of soft iron, which in the magnetic field of a permanent magnet is made a magnet by induction, when exactly in this line, if of a size and thickness rightly proportioned to the size of the magnet, has no polarity, will neither attract nor repel, but appears to have the magnetic influences from the permanent magnet so balanced in itself that, if a magnet still, it exerts no magnetic forces. This neutral line is the leading fact which makes the other facts of Mr. Gary's discovery possible. Secondly, the armature, or piece of soft iron, when in the field of the permanent magnet, although exhibiting no magnetic force, while exactly on the neutral line, instantly possesses polarity and will attract or repel when moved ever so little off from this line, whether toward or away from the magnet. Thirdly, and what is most remarkable, when moved from this line nearer to the magnet, yet not in contact with it,

the armature has polarity the same as the magnet, but when moved from, or across, the neutral line further away from the magnet, it has polarity opposite to that of the magnet. This change of polarity in the armature, produced simply by change in its position, and produced instantly and as often as its position is changed from one side to the other of the neutral line, is the fact that makes the magnetic power available.

THE PHONEIDOSCOPE.

An instrument with the above-mentioned name was presented to the Societe Francaise de Physique, at its last sitting, by the inventor, M. Taylor. Its object is to show, optically, the delicate peculiarities of sonorous vibratory movement. A thin film of liquid glycerine is formed on a small opening made in a piece of blackened brass, and it reflects the light of a lamp in producing either on the retina direct or by production on a screen, the well-known iridescent effects of the transparent plates. As long as the film is motionless, the simple colors of iridescence are alone visible. But if, by means of a bent tube, the vibrations of a sustained sound are conducted underneath that film, by the voice or otherwise, the film begins to vibrate and the colors are distributed geometrically, producing on the surface fixed bands and moving rings, the disposition of which varies with the depth of the tone and the nature of the harmony accompanying it—that is to say, the pitch. M. Taylor showed, by projection, that the acoustic figures thus obtained become more and more complicated as the tone emitted rises, or when, the height remaining constant, different vowels are pronounced. The colors thrown on the screen differed during the experiment in proportion as the film became thinner by evaporation, but the acoustic figure did not vary. The results obtained are extremely curious and of varied appearance, according as apertures of different forms are used. M. Taylor projected the phenomena produced by openings triangular, round and square, by means of the Drummond light. The considerable heat which accompanies that process of lighting causes, after a certain time, the evaporation of glycerine, and terminates the experiment. But its duration may be augmented by passing the luminous rays through a glass flask filled with water, which deprives them of the greater portion of the qualities absorbable by the liquid glycerine.

THE WALLED LAKE IN IOWA.

The greatest wonder in the State of Iowa, and perhaps any other State, is what is called the "Walled Lake," in Wright County, twelve miles north of the Dubuque and Pacific Railway, and 150 miles west of Dubuque City. The lake is from two to three feet higher than the earth's surface. In some places the wall is ten feet high, and fifteen feet wide at the bottom, and five feet wide on top. Another fact is the size of the stones used in construction, the whole of them

varying in weight from three tons down to one hundred pounds. There is an abundance of stone in Wright County, but, surrounding the lake to the extent of five or ten miles, there are none. No one can form an idea as to the means employed to bring them to the spot or who constructed it. Around the entire lake is a belt of woodland half a mile in length, composed of oak. With this exception the country is a rolling prairie. The trees must have been planted there at the time of the building of the wall. In the spring of the year 1866 there was a great storm, and the ice on the lake broke the wall in several places, and the farmers in the vicinity were obliged to repair the damages to prevent inundation. The lake occupies a ground surface of 2,800 acres; depth of water as great as twenty-five feet. The water is clear and cold; soil sandy and loamy. It is singular that no one has been able to ascrtain where the water comes from nor where it goes, yet it is always clear and fresh.—*Dubuque Herald.*

HONORS TO THE LATE PROF. HENRY.

On the afternoon of January 16th, in the National House of Representatives, memorial services in honor of the late Professor Joseph Henry were held in the presence of a vast audience. The President and his Cabinet, Chief Justice and Associate Justices of the Supreme Court, the United States Senate, the alumni of Princeton College, and members of the various societies with which Professor Henry had been associated occupied seats on the floor, as did also a number of ladies. After the opening prayer by Dr. McCosh,. of Princeton, addresses were delivered by Vice-President Wheeler, after reading the address of Senator Hamlin, who was unable to be present, President Withers, Professors Gray, of Harvard, and Rogers, of Boston, Representatives Garfield and Cox, of New York, and General Sherman. Prayer was then offered by Rev. Byron Sunderland, and the invited guests having retired, the House adjourned.

ENGLISH ADVICE FOR COLD WEATHER.

The London "*Medical Press and Circular*" says: "We are in the midst of a severe winter, and as hygiene is the order of the day, we cannot be too particular in impressing upon the public certain facts which are too often disregarded. Few are aware of the killing powers of the intense cold and great heat, even in this comparatively temperate climate. Those who have been in the habit, as we have, of watching the returns of the Register-General, well know how quickly the death rate rises during even a short continuance of cold weather. Now, the fact that the increase in the mortality affects chiefly the young and old, as well as those who are either suffering from or are predisposed to, affections of the chest and throat, indicates the class of people who should be especially careful to protect themselves against the inclemency of the weather. With regard to children,

the system of hardening them by allowing them to go thinly clad and exposing them to all sorts of weather, is a delusion from which the minds of some parents are even now not altogether free. It is thought that if their chests are kept warm, there is no need of caring about their arms and legs. But this is a mistake. In proportion as the upper and lower extremities are well clothed will the circulation be kept up and determined to the surface of those parts, and in proportion to the quickness and equable distribution of the circulation will be the protection against those internal congestions which are but the first stage of the most fatal disease of infancy and childhood. The same observation holds good with respect to grown-up people who are predisposed to pulmonary complaints. There is no exaggeration in saying that the mortality from those and other affections would be considerably diminished were people to avoid that "catching cold" of which they so often and so lightly speak; and it is a matter of surprise to us that this fact, of which most of us are aware, does not lead to more precautions being taken by those who are anxious about either their own health or that of others. To take care that the body is thoroughly warm and well clothed just before going out in very wet or cold weather—to keep the circulation and warmth of the body rather by exercise of some kind than by sitting over great fires or in over heated rooms—to be sure that the temperature of the sleeping apartment is not ever so many degrees below that of the sitting room, these are three golden maxims, attention to which would prevent thousands from catching that chill or "cold," to the results of which so many valuable lives have been prematurely sacrificed.

THE MINERAL SPRINGS OF COLORADO.

Idaho Springs is one of the oldest of Colorado watering places, and possesses, in an eminent degree, the characteristics and surroundings of a popular health and pleasure resort. Located thirty-four miles from Denver, by rail, in the valley of South Clear Creek, it is sheltered from the winds, and at an elevation of 7,800 feet above the sea, has a most delightful and health giving climate; surrounded by high and well-known land marks which, like the "Old Chief," "Squaw," and "Papoose," lift their heads from 10,000 to 11,000 feet; possessing a number of medical springs, impregnated with iron, lime, soda, sulphur and magnesia; provided with ample hotel accommodations; surrounded by picturesque drives and walks, Idaho Springs possesses many advantages over other Colorado resorts. Its proximity to Denver, Georgetown, Central and other interesting mining and business communities; its large and well-conducted swimming baths; its eight soda springs—unite to render it one of the most attractive spots in Colorado and a favorite resort for invalids and tourists who come for rest and comfort.

In the language of a tourist whose travels have led him to all the prominent pleasure resorts and watering-places of Europe, as well as of this country, Idaho

Springs is, perhaps, for the tourist, the most celebrated resort in Colorado. Easy of access from Denver; 7,330 feet above the sea level; the location of some of the most efficacious mineral springs in the State; surrounded by scenery bold, grand and novel, it attracts a large and increasing throng of visitors. No tourist should come within a day's journey of Idaho Springs, without enjoying the satisfaction of a plunge in its famous swimming baths, the largest of which, the "Mammoth," is thirty by fifty feet in size, and five feet in depth; the hot soda water, which pours in from the spring, being regulated to suit the bathers of the season; connected with it is a large shower-bath, comfortable dressing rooms, a barber shop, and all necessary appliances. The sensation produced by a plunge in this warm, soda water bath is peculiarly delightful, and, for rheumatic affections, wonderfully efficacious.

A short distance from the above is a smaller swimming bath, the "Ocean," twenty by forty feet, and four feet in depth, generally used by ladies, who form into pleasant parties from the hotels and generally bathe in the evening. This is also fitted with a cold shower-bath, comfortable dressing rooms, and is provided with polite female attendants. The medicinal properties of the baths are considered equal, and, by very many, superior to Baden, Ems or Weisbaden, of Germany. There are private bath rooms, where the natural temperature of the water at 110°, can be enjoyed.

Near Soda Creek there is a cold soda spring which is strongly impregnated with sulphur, and is very effervescent and sparkling, and makes a delicious beverage. Dr. I. G. Pohle, of New York, made a chemical analysis of the water from the Hot Soda Springs, and found it to yield the following constituents, in the annexed proportions, to the gallon:

Carbonate of Soda	30.80
Carbonate of Lime	9.52
Carbonate of Magnesia	2.88
Carbonate of Iron	4.12
Sulphate of Soda	29.39
Sulphate of Magnesia	18.72
Sulphate of Lime	3.44
Chloride of Sodium	4.16
Chlorides of Calcium and Magnesium, of each, a trace..	
Silicate of Soda	4.08
Grains	107.08

—*Colorado Tourist.*

FLOWER SEEDS FOR SPRING PLANTING.

If you have no experience, select the kinds most easily grown, such as Asters, Balsams, Petunias, Zinnias, Dianthus, etc., with only a few of the more difficult. Great care should be had to select seed suited to the purpose for which they are designed. If we wish to cover a fence or veranda quickly, the Morning

Glory or Nasturtium, or some of the free-growing, hardy climbers should be chosen. If the object is a showy bed on the lawn or the border, in addition to the bedding plants, such as the Geraniums, the Petunias, the Phlox Drummondi, the Verbena, and such flowers as continue in bloom a long time and make a gay show of colors, are desirable. For taller flowers, a back-ground in the garden, the Zinnia, Marigold, Gladiolus, and flowers of this character should be selected. For cutting for small bouquets there should be some beds of Mignonette, Sweet Peas, Alyssum, and other fragrant flowers, with the fragrant-leaved Geranium.—*Vick's Floral Guide for 1879.*

THE AXOLOTL NOT A DEVELOPMENT LINK.

Another sensation is likely to be created among evolutionists by the discovery of Dr. Weisman, of Freiburg, that the axolotl, whose change from a fish form to that of an air-breathing lizard has been hailed as an unmistakable proof of the development theory, really never makes this change except under forced conditions, and when it does so reverts to a lower form; since, after such a change, it loses the power of reproduction, while the axolotl itself if left in its native waters breeds freely, reproducing its own form and species only.

Professor Stanley Jevons urges the importance of at once undertaking direct observations of the varying power and character of the sun's rays, asserting that, while hundreds of meteorological observers are registering at every hour of the day and night the most minute facts about the atmosphere, the very influence upon which all atmospheric changes ultimately depend, the *solar radiation*, is not measured by any of them, at least not in the proper manner.

NO DYSPEPSIA IN OLD TIMES.

Benjamin Wolsey Dwight states in his "Memoirs of the Connecticut Academy of Arts and Sciences" (1811), that dyspepsia is a modern disease in this country, and was scarcely known until the present century. This he attributed to the paucity of carriages up to that date, whereby both sexes were compelled to travel on horseback; the fact that, so far as men were concerned, by far the greater part combined some agricultural work with their other avocations, and that patent bitters and other stomach destroying stimulants were not in existence.

A VOLCANO DISCOVERED IN KANSAS.

A peculiar phenomenon is reported about twelve miles north of town in the bluffs. A man was out there hunting rabbits, and while there he noticed a lot of smoke coming from one bluff, and he went to it. To his astonishment he dis-

covered that the smoke was issuing from a large hole in the ground, and also the ground was so warm that the snow had melted from the bluff. The smoke still continues, and there is some excitement in that neighborhood, the people believing that a volcanic eruption or an earthquake is imminent. Our informant is truthful, and he will give the scene a visit to-morrow to investigate the matter. —*Cawker City Free Press, Jan. 11.*

EDITORIAL NOTES.

THE Kansas City Academy of Science met Dec. 31, 1878. The room was filled, President Van Horn in the chair.

Judge E. P. West read a very interesting paper upon "The Footprints of Primitive Thought," which was attentively listened to, and afterward freely criticised and discussed. It will be found in full in this number of the REVIEW.

Theo. S. Case read the usual monthly abstract of Scientific Progress, after which Professor Greenwood demonstrated orally that The centrifugal force on the Earth's surface decreases as the square of the cosine of latitude from the equator to either pole, being one of the questions announced for discussion at the last meeting. The other question as to the connection between the maxima and the minima daily variations of the barometer and the magnetic needle, was, at the request of Professor Parker, made the subject of discussion for the next meeting.

T. S. Case, in behalf of H. C. Lea, of Philadelphia, presented to the library of the Academy a handsome octavo copy of Rodwell's Dictionary of Science, which, on motion was placed in charge of the Librarian, and the Corresponding Secretary directed to tender the thanks of the Academy to Mr. Lea.

At the next meeting papers will be read by Prof. C. E. Robbins, of Summit, Colorado, and Mr. Greeley, of this city. Col. Van Horn, being necessarily absent from home, will read his paper at the (February) meeting.

Professor Greenwood was appointed to prepare and read the monthly summary of scientific progress at the next meeting, which will be held on the 4th Tuesday of this month, January 28th.

ARRANGEMENTS are in progress to celebrate in some sufficiently important way at Penzance the centenary of Sir Humphrey Davy's birth. The great chemist was born at Ludgvan, near Penzance, in Dec. 17th, 1788, and was educated and served his apprenticeship to a surgeon in that town, where he acquired the rudiments of the science in which he has become so distinguished.

PROFESSOR PALMIERI, who has devoted his life to the study of Mount Vesuvius, has an observatory situated on a long and narrow ridge of rock on Mount Catroni, almost at the foot of the actual cone of the volcano, half a mile from the Hermitage of San Salvatore, the extreme point to which carriages can ascend the mountain. In spite of the risks, the Professor has remained at his post, and chronicled features of the eruptions of the last six years.

MR. DAVID ECCLES, of this city, in a well written communication to the *Times*, concerning the alleged recent discovery of the compound nature of the so-called chemical elements, calls attention to a letter received by him from his brother, Prof. R. G. Eccles, of Brooklyn, N. Y., some three years since, in which the professor clearly points out the remarkable structure of some of the homologous groups in organic chemistry, as well as the peculiar allotropism of certain classes of the inorganic elements. It is an article of no ordinary interest, and just at the present time, when the discoveries of Lockyer are agitating scientists everywhere, it will be read with avidity by all.

AT the last meeting of the Leavenworth Academy of Science, which was held on January 9, a paper was read by W. S. Burke, editor of the *Western Homestead*, upon the "Impending Revolution," of which the Leavenworth *Times* gives the outline, as follows:

The speaker took up the subject of the bearing of labor-saving machinery upon the labor markets of the world, and undertook to show that since machinery had enabled a portion of the working force of the community to supply the physical wants of the whole, it would be necessary to educate the taste for the ornamental and the beautiful, to make a greater demand for something beyond the strictly useful, in order to furnish employment to a larger proportion of the people in lines of work not directed especially to supplying the physical wants of mankind.

At the next meeting, January 23, Prof. G. E. Patrick, of the State University, will read an essay entitled "Chemistry in the Arts."

The phenomenon of a beautiful rainbow in the zenith of the heavens, forming a complete circle, attracted general attention about eleven o'clock this forenoon and set the scientific heads to pondering. It was a strange sight to see at a time when such phenomena are unusual, and particularly on a day when the necessary element of water in the heavens did not exist. Let us hear from learned minds on the subject.—*Atchison Patriot, Jan.* 8.

The phenomenon was evidently that known as a "halo," which is explained upon the hypothesis of snow or ice-crystals falling slowly in a calm atmosphere, and is due simply to the refraction of the solar rays upon crystals of ice, producing all around the sun, and at the same distance, a series of luminous impressions. Flammarion, in his work on The Atmosphere, gives a very full and minute explanation of the whole subject.

DR. EDWIN R. HEATH, of Wyandotte, Kansas, whose interesting description of the Antiquities of Peru appeared in the November number of the REVIEW and has been widely copied, sailed from New York Nov. 18, for Peru, intending to complete the exploration of South America commenced by Professor Orton, an undertaking he is well fitted for from inclination and experience.

IT is reported that a Brooklyn inventor, after years of experiment, has constructed an electric engine. The machinery necessary to run an ordinary sewing machine needle through any thickness of cloth is contained in a small box eight inches square and four inches deep. A small battery furnishes the electricity and may be at any distance from the machine, the distance governing the size of the wire connecting the two. The expense is small, as the battery is the only constant expense, and this costs only a few cents a day while in use. The speed at which the machine is run and the stopping and starting are entirely under control of the operator, being governed by a switch on the cloth plate. Its successful working has been shown in public.

SINCE our last issue a very important educational association, known as the Missouri Valley Teachers' Association, has held a session of three days in this city. Several of the essays read before it were of the highest order. We are only enabled to present our readers with one of them, that of Professor Nipher, of St. Louis, in this issue, but hope at some future time to obtain others. At nearly the same time the Southwest Missouri Teachers' Association was in session at Springfield, Mo., and according to the local papers it was equally interesting and important with that held here.

KANSAS CITY received one-fifth as many hogs at her stock-yards in 1878 as there are in all England, and more than one-sixth as many cattle as there are in Great Britain. That will do very well for a live-stock market only eight years old.—*K. C. Journal.*

The *Mining Record* says that during the ten months of 1878 ending October 31, the excess of imports over exports of gold and silver coin and bullion was in England $16,820,000, of which only $194,000 was silver, the remainder—$16,626,000—being gold; in the United States $6,016,869, of which only $1,138,565 was gold, the remainder—$4,878,304—being silver; in France, $62,534,000, of which $21,162,000 was silver, the remainder —41,344,000, being gold.

THE Kansas Historical Society proposes to erect a statue of Hon. Eli. Thayer, as a perpetual memorial of his services in behalf of the freedom of that State.

THE articles of Judge West, of this city, and of Rev. Noah Porter, of Yale College, published in this number of the REVIEW, may be regarded as fair examples of the extremes of antagonistic reasoning, and as such we commend them to the careful consideration of earnest and thoughtful readers.

ITEMS FROM THE LEADING PERIODICALS.

WE present our readers in this number an abstract of Prof. Lockyer's much-looked-for paper on the compound nature of the elements, taken from the *London Chemical News*, by which it appears that the alleged discovery is the result of spectroscopic rather than of chemical observation. Since, as has been well said by *Iron*, "it is easy to frame a plausible spectroscopic theory to the effect that complex spectra are built up of simpler spectra, and that, therefore, the elements giving complex spectra are probably built up of the elements giving the simpler ones," we perhaps had better await further proof before acknowledging that our entire system of chemistry must be revised.

The *American Naturalist*, (McCalla and Stavely, Phila.) contains as usual a complement of excellent and interesting articles; notably, those by Prof. Baird, on the Breeding habits of Eels, Lieut. Vogeles on A Lost Race in America, Alfred W. Bennett on The Absorption of Water by the leaves of Plants, etc. To us the general notes are always attractive and "full of meat" Among them in the January number we observe an item taken from Prof. Brooks' report announcing that *Lingulæ*, a Brachiopod which has hitherto been credited with resisting development, evolution and change of any kind from the remotest fossiliferous ages, has upon closer study, been found to have "transmitted to its children a developmental record which proves that *Lingula* itself is the *descendant of a much older form.*" *Nil disputandum.*

The valuable series of articles on House-building in the *Boston Journal of Chemistry* continues into 1879, and gives additional value to that popular periodical.

Dr. H. Carrington Bolton of Trinity College, Hartford, Conn., contributes to *Science News* of January 1st, 1879, an interesting description of the new elements discovered since 1877, viz: Davyum, discovered by Kern and named after Sir Humphrey Davy; Mosandrium, discovered by Prof. Lawrence Smith, of Louisville, Ky., and named after the Swedish chemist, Mosander; Phillipium, discovered by De La Fontaine and named after M. Phillipe Plantamour, of Geneva; Yterbium, discovered in the earth yttria by Prof. Marignac, of Geneva; Decipium, discoved by De La Fontaine and so named because of its deceiving qualities, (from *decipio*) to deceive.

Appleton's Journal opens the year with an excellent number replete with good articles. Fiction, history, hygiene, science and art, all find place in its pages, and add to its value as a family magazine. It has ceased to be an illustrated periodical, which we think a mistake, and devotes its space to the best articles to be found in the current literature of the day.

The *Journal of the Franklin Institute*, among other valuable matter, including the continuation of Dr. Hoffman's exhaustive series of articles upon the Development of the Chemical Arts within the last ten years, gives space to an elaborate description of an Automatic Tit-tat-to Machine, with seven wood cuts and several diagrams and tables, by Frank G. Freeland, and closes with the usual "Items," which embrace brief abstracts by competent writers, of scientific articles on all current topics.

M. Darlincourt having recently perfected a telegraphic instrument, which transmits messages in the actual hand writing of the sender, the *London Telegraphic Journal* of December 15th, gives *fac simile* copies of such dispatches, as well as a copy of a landscape sketch transmitted over the lines between London and Birmingham.

The *International Review* has introduced an innovation in review literature, in the way of a tale by Wilkie Collins, called A Shocking Story. For this the editors will be thanked by many of their readers and found fault with by others, who, when they buy a periodical with a Turveydrop title, want "deportment" and nothing else. However, they cannot find much to complain of, as only twenty-nine pages out of one hundred and eighty four are given to the story, while the remainder are filled with articles of the best quality by some of the ablest writers of the day. We regard the Book Reviews of the *International* as especially full and reliable. With the year 1879 it follows the example of the *North American* and becomes a monthly at the same price as heretofore.

The *Popular Science Monthly* comes to us this month, enlarged to 144 pages and apparently improved and increased in every respect except price, which remains as formerly, notwithstanding that the Monthly has absorbed the *Supplement*, and consequently ought to be worth twenty-five cents more than heretofore. Among the many excellent articles none have interested us more than Prof. Carhart's Astronomical Magnitudes and Distances; M. F. Maury's Black Diamonds, and Molecular Dynamics by L. R. Curtiss. Living fully up to its name, it is the most popular Science Monthly in this country.

The Literary World (E. H. Hames & Co., Boston), always sprightly and entertaining, and at the same time reliable and just in its comments upon new books, changes form with the January 4th issue, becoming a fortnightly instead of a monthly, and raising its subscription price to $2.00 per annum. It will increase its attractiveness by publishing a series of "Short Studies of American Authors," by Mr. T. W. Higginson. These papers will be both critical and descriptive, but their subjects will not be announced in advance.

The *Sanitarian* devotes some twenty-three pages to the Yellow Fever discussions of the American Public Health Association at Richmond, Va., Nov. 1878, and thereby presents to its readers the most complete compendium of practical information yet published on that important subject.

The *North American Review*, since its removal to New York City, seems to have laid aside some of its pristine massiveness and taken on a new life and activity, better adapted to the modern times and practices. This is especially noticeable in its change with the commencement of the new year from a bi-monthly to a monthly, with price unchanged. The January number contains a number of fresh, timely articles, political, historical, critical and financial. Among the most interesting are those of Senator Edmunds upon the Canadian Fishery award, W. W. Story upon The Pronunciation of the Latin Language and Capt. Howgate descriptive of the Cruise of the Florence.

The Gardeners' Monthly for January, 1879 pays a fitting tribute to the memory of the late Dr. J. H. Klippart, for so many years Secretary of the Ohio State Board Agriculture and also well known through his labors in botany and horticulture. His health has been feeble for some years, but he worked on unremittingly and at last literally wore himself out in his devotion to scientific studies.

The Engineering & Mining Journal commences its twenty-seventh volume with several important improvements, such as a regular Record of progress in science and the arts a popular epitome of Scientific news and progress in Mechanics, also a monthly supplement devoted exclusively to the Coal and Iron trade and other matters pertaining thereto. In doing this it incorporates with itself the *Polytechnic Review*, being the third periodical it has absorbed within the past few years, and making it without doubt the best journal of its class in the country. The admirable illustrations contained in the issue of December 21st have been largely commented upon by the papers everywhere, and deservedly so, for so far as we have observed they have not been equalled by any other periodical in the United States.

Kansas C. Rev.

That the publishers of *The Atlantic Monthly* intend to maintain the high character of the magazine in all departments during the year 1879 is fully shown by their programme for the coming volumes. The most able writers will treat of topics of political, economical and social interest; serial and short stories by the best American authors will be given; and the admirable critical papers, transatlantic sketches, studies in art and history, etc., which have been found so attractive in the in the past, will be continued.

Sunday Afternoon, for January, reached us in good season and proves to be just what a family needs for the relaxation of mind among the weary old folks and the quiet entertainment of the younger ones. All of its articles are original and have a healthy, moral tone, while discussions of religious subjects always form a portion of its contents. It numbers such well-known writers as Prof. Francis A. Walker, Rev. Leonard W. Bacon, Elizabeth Stuart Phelps, Rose Terry Cooke and many other familiar popular essayists.

Among all of our literary exchanges, few give us as much gratification in the reading as *The Library Table*. Its Briefs on New Books are kept fully up to the times, which is no small matter in the flood-tide of fresh literature of the present day—and they are keen, faithful and impartial. Next to the review feature, come Literary news and Records of new books, which afford just the information needed by readers and students. A few pages are always devoted to fiction, and the serial tale, "Rutherford," now occupying that portion of the magazine, is exceptionally interesting and well sustained. The chapter of Contents of Periodicals is, of itself, almost equivalent to an index of the leading scientific, religious, medical and literary journals of the day.

Besides the very valuable archæological article on "The Origin of Metallurgy," which we are reproducing from *Van Nostrand's Magazine*, the January number contains one on "The Physics of the Missouri River," in reply to Capt. Eads; a most valuable one on "Sanitary Science in the United States," by Prof. A. R. Leeds, Ph. D.; a compilation of the history of Electric Light, and a number of others equally important, but more strictly technical.

PROF. DASCOMBE GREENE, of Troy, N. Y., describes in the *American Journal of Science and Arts*, for January, a paper dome, devised by him, for an astronomical observatory. It is a hemisphere of paper stretched over a wooden frame, with an outside diameter of twenty-nine feet, and vertical height of about ten feet. It is composed of sixteen equal sections, which were formed over a model, covered with paper about one-sixth of an inch in thickness, and thoroughly painted. These sections were then placed in proper position and bolted together and the joints properly closed against the weather An opening left at the top was also covered with a shutter of paper, treated in the same manner. The whole dome, weighing 4,000 pounds, rests on six 8-inch cannon balls which roll between grooved iron tracks, and is easily moved by moderate pressure without the aid of machinery; whereas, a dome of similar size, constructed in the usual manner, would weigh from five to ten tons and require the aid of cumbersome machinery to revolve it.

Prof. E. T. Nelson, of the Ohio Wesleyan University, is editing the Scientific Department of the *Farm and Fireside*. published at Springfield, Ohio, and writing a series of popular articles on Conchology, which will be of the greatest sevice to those who are fortunate enough to read them.

Prof. Geo. Reuling M. D. gives in the *New York Medical Journal* a most careful and precise description of his manner of operating for cataract by removing the crystalline lens with its capsule uninjured, all other operations only aiming at the extraction of the lens alone, leaving the enveloping capsule *in situ* and more or less obstructing vision.

All of the above periodicals can be had at a good discount through the publisher of the KANSAS CITY REVIEW, and any book published by any leading house in the country, at advertised rates, postpaid.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. II. FEBRUARY, 1879. NO. 11.

GEOGRAPHY.

LIFE AT TIMBER LINE.

BY PROFESSOR C. E. ROBINS, SUMMIT, COLORADO.

I have been asked to communicate to the Kansas City Academy of Science a narrative of my experience in the Rocky Mountains, so far as the latter may seem to me to possess general interest for an audience of the character assembled here.

It has not been practicable, in consequence of my absence from accumulated data, to prepare a careful scientific paper for this occasion; and I, therefore, merely design stating from memory in a conversational way, some matters that present themselves in the general mass of recollections growing out of a residence embracing portions of five years—and covering nearly four years of continuous time—at the summit of the Sierra Madre, in Southwestern Colorado. In what I have to say, I shall confine myself to the Summit Mining District and to facts and occurrences personally observed.

The location to which reference is made is most widely known as the Little Annie mining camp, and is situated near the base of South Mountain in Rio Grande county. More definitely, the point is in N. lat. 37° 28′ 18″, near W. long. 106° 30′, and according to Lieut. Wheeler, 11,300 feet above tide. It is almost accurately in line with Syracuse, the most southern city in Europe, and is at the same distance from the equator as Melbourne, the most southern city in the world. Although the Annie camp is everywhere known as "the Summit," it is, in fact,

situated in the trough of a synclinal marked on the south by South Mountain 12,500 feet, and on the north by Summit Peak (the Mt. Belleview of Hayden's Drainage Map of Colorado) 12,748 feet high. At the triangulation monument on the latter, may perhaps be had as vast and impressive a mountain outlook as can be found in the United States. Besides a number of peaks over 13,000 feet in altitude, showing on their upper slopes, during the whole summer, snow fields which have probably presented nearly the same general mass and outline in July and August every year since the Jewish exodus, there rises in clear view 65 miles northwest, the giant form of Uncompahgre, 14,205 feet elevation; and 64 miles East, Blanco Peak, the loftiest pile over which that unhandsome fowl, the bald-headed eagle, can fly and be at home, 14,464 feet above the sea. For a hundred miles in every direction, over Colorado and New Mexico, and perhaps into Utah and Arizona, the eye surveys the mightiest monitors of telluric disturbance in America north of the Mexican line.

On the 29th of July last, the solar eclipse of that date was observed from the monument on Summit Peak under instructions from the Signal Service Office at Washington. I wish I could convey to you in adequate words the weird vision that swept down from the northwest through the pulseless stillness, of the upper air over the frozen rock billows of the upper lands. But I believe that neither Starr, nor Clarence King, nor John Ruskin—the three men in whom the changeful glories of the mountains have most truly voiced themselves, could do that. I certainly shall not try.

The day of the eclipse was the only occasion when I have known the air at rest as high up as 12,000 feet. It was a favorable circumstance, as were all others connected with the observation.

Since August 1st, 1876, careful meteorological records have been kept at the Little Annie office. They have been as comprehensive as instrumental means allowed. Although the loftiest station except Pike's Peak reporting to General Myer, being a "volunteer," it has unfortunately been without automatic registering appliances of any kind, without barometer, anemometer or psychrometer, without meteorological tables, and several other desiderata. The absence of these has confined observations mainly to temperature, precipitation, sky readings, estimated air movements, and casual phenomena.

Before giving a brief abstract of climate at 11,300 feet in the latitude of Richmond, Va., let us consider the most important factor in that of the Summit, viz.: elevation. The equivalent of altitude for latitude is approximately expressed by saying that every 1,000 feet of elevation corresponds to a removal of 3° of latitude from the equator. This rule would add (climatically) 34° of N. latitude to the geographical position of the Summit. $37° \ 28' \ 18'' + 34° =$ about 71° 30′ N. Now, if you will consult an atlas, you will find that this takes you a considerable distance toward the pole; about 5° inside the Arctic Circle. The line passes to the north of every settlement made by man in Europe and Asia; and north of all except Upernavik, in America. When, however, we get as far as this toward where the meridians meet, we are not quite certain of our rule.

I do not know if weather records are kept at Upernavik, and think a nearly six months' absence of solar rays likely to lower the annual average of temperature beyond the reading of the scale given. Still, we have at the Little Annie, the loftiest gold mine worked on the globe, an Arctic climate, as distinctly marked by its fauna and flora, as by the monthly and annual averages of the spirit thermometer.

The following is a brief of temperature and precipitation at the Summit Signal Station during the twelve months ending June 30, 1878:

MONTHS.	TEMPERATURE.			TOTAL RAIN &	TOTAL
	MEAN.	MAX.	MIN.	MELTED SNOW	SNOW-FALL.
July 1877	52.8°	69°	43°	3.6 inches	0. inches.
August . . . . . "	51.5	63	43	2.44 "	1. "
September . . . "	43.0	61	26	3.7 "	11.5 "
October . . . . "	27.5	52	2	4.4 "	44.0 "
November . . . "	13.7	42	—24	0.9 "	9.2 "
December . . . "	10.3	40	—22	1.0 "	10.0 "
January 1878	6.3	32	—21	0.7 "	7.0 "
February . . . "	6.0	32	—18	2.96 "	29.6 "
March . . . . . "	17.1	48	—12	5.6 "	55.75 "
April . . . . . "	22.9	48	—2	5.125 "	51.25 "
May . . . . . . "	31.5	54	14	1.3 "	13.0 "
June . . . . . . "	40.8	66	26	2.985 "	14.52 "
Sums.	323.4	605	55	34.710	246.82
Means.	26.95	50.4	4.58		

Compendiously stated, the highest temperature reached during the year was 67°+ Fahr., the lowest 24°—, the mean of maximum temperatures was 50°.4+, the mean of minimum temperatures was 4°.6+, and the average annual temperature 5° below freezing point.

Snow has occurred during every month save July since observations began, 29 months ago. *Last* July furnished us with two considerable snow storms, and the column of snow-fall in the *next* annual summary will be unbroken. Hail is frequent during the summer, and few nights pass without frost. Winter begins about the 5th of September and ends about the 10th of June. We have no spring or autumn. Twice the amount of snow falls in March, April and May that reaches us in December, January and February. The annual crop of "the beautiful" is about 24 feet.

I will say here, that the thin, almost vapor-void atmosphere at 12,000 feet altitude is scarce ever *chilly.* When the temperature rules as low as 10° below zero, the air is generally still. In over 400 miles of travel on snow shoes I have never worn an overcoat or an overshoe, and have rarely felt as cold as I have, heavily dressed, during the present week in Kansas City. The upper snow is like corn meal, light and dry; it rarely gives in melting over 1-10 its bulk of water. At all seasons, the ground below the surface is frozen to an unknown depth; no excavations in mines or elsewhere having passed the line of perpetual congelation.

The 4th of July, 1877, was celebrated at the Summit by a snow shoe and

snow-balling party, in which seven individuals present in this hall participated. Four of them, who had been accustomed for a number of years to fan themselves and fight mosquitoes in the woods of Staten Island on that date, will recognize one marked exception to their previous thermal experiences in endeavoring to commemorate the adoption of Mr. Jefferson's essay. An account of the unique doings on that occasion of these stray Staten-Islanders, was published by the Chief Signal Officer of the Army in his Weather Review for the month named.

From the middle of November to the middle of June, extensive outside locomotion is limited to snow-shoeing. The latter is performed on runners of the Norwegian pattern, and their facile use involves considerable dexterity. When one first mounts two strips of timber 10 to 12 feet long, and tries to stand up on them going down a gravity-impelling grade—one is apt to encounter unexpected experiences. Somehow, one or the other leg is sure to get irretrievably in advance of its mate, and there is a capsize, a *bouleversement* of the entire animal economy. This does no harm to the novitiate who is wrestling with snow shoes, and is productive of inexpressible and prolonged cachinnation to the lookers-on. Snow-shoeing is grand sport; better than skating and devoid of its dangers. It works no bodily ill to be shot into three or thirty feet of snow. There is little danger of bone-fracture, and none of drowning. The best "snow shoe man" that ever came under my observation, was a woman; graceful as a bird in flight—and good for twenty miles an hour on a hard track and sharp grade. The Canadian or web-foot snow shoe is not, save occasionally by new comers, in use in the mountains.

Snow-slides, in immense masses, occur during the spring months. Where they strike the heaviest timber, or the firmest structures—the latter are literally shaved from the ground as by some cyclopean mower. For many years the track of one near the Summit will be visible, where in a heavier forest than there is in Missouri, a road a hundred feet wide and half a mile long, has been cut as straight and clean as any street in Kansas City.

Of casual phenomena, the number of "cloudless days", (I use the term strictly—days when from sunrise to 9 o'clock P. M. there is not a filament of cirrus on the concave,)—is perhaps the most remarkable. Fourteen of them were noted during the twelve months ended 31st July, 1877. On the 11th, 12 and 13th of August 1876, the sun, moon, and several stars, were visible from 10 o'clock A. M. to 2 o'clock P. M. On the evening of the 4th of the same month, perhaps the most splendid lunar rainbow ever witnessed, was exhibited to the dwellers on the Summit. It appeared about 9 P. M., the moon being full, and lasted fifteen minutes. The chromatic scale was complete in the primary, and the secondary arc was perfectly defined around the entire semi-circle. The upper outlines of the mountains were but faintly discovered through the blackness of the storm, while the valley of the North Alamosa was flooded under the arch with an inundation of intense but indescribable light; brighter than that under the most brilliant aurora, but golden. As no words can convey such a picture, we were fort-

unate in having present at the time an artist who has perpetuated the scene in colors that will not fade.

Of parhelia, we have about half a dozen striking exhibitions annually. Meteors are frequent. Paraselenes, aurora borealis, and mirage, have not been observed.

Repeating that on the Sierra Madre in Southern Colorado we have two seasons—summer, where it rains almost daily—and winter, in which a large majority of the days are clear,—I dismiss matters of situation and climate.

It is known to you that the Rocky Mountains represent the latest extensive line of out-thrust and disruption on the earth's surface.

The main axis of the Saguache range is felspathic porphyry, intercalated with occasional granite and trap. The only fossil yet seen in the Summit Mining District is a tree trunk silicified and partially carbonized, lying at over 12,000 feet elevation,—of tertiary or later origin. A narrow seam of impure coal is found near by.

First of existing fauna comes *Ursus ferox*, (Var. cinnamom) the largest native mammal on our side of the world. Next is *Felis concolor*, or mountain lion, —the most formidable of the American cats. Then follow the black bear, elk, mountain sheep, mountain wolf, red, black and cross fox, porcupine, ground hog, fisher, marten, rabbit, squirrel, weasel, coney, chipmunk, mountain rat, mouse, and mole. Of birds, we have hawks, owls, ducks, grouse, quails, doves, ravens, black birds, snow birds, camp robbers and woodpeckers. Of insects, the cosmopolitan horsefly and musquito, the bumble bee, honey bee, locust, spider, gadfly, white and yellow butterfly, hornet, and several species of myriopoda. There are no snakes on the ground and no fish in the waters. Leeches have been the only living thing found in the latter. Careful search for snails has not produced a helix.

The magnificent forests of spruce and fir that meet across the gulches and rise at 12,100 feet to timber line, must have foremost mention in any view, however brief, of the Alpine vegetation of the Summit. I counted upwards of 400 annual rings in one of the "forest monarchs" felled for a battery sill in the Annie mill, and gazed with the brief wonder of an ephemeral existence on a life ended before its time—that yet had braved the tempests of four hundred Summit winters—that sat serenely under Summit skies when Columbus was a boy, and had replanted its race before Luther was born. Forests covering thousands of square miles that will cut 40 to 60 cords to the acre, are not the least of the gifts of the Great Hills. We all owe a grateful debt to Secretary Schurz for his initiative in regard to the spoliation and waste of timber on the public lands. If the latter is suffered to go on unchecked for a few generations, it will turn the western plains, which the labor of man is converting from a desert into a garden, back to a desert again. The forests do well enough without man—but man cannot live without the forest.

Every plant at the Summit over six feet high is a conifer—an evergreen. All, spruce and fir. Even the pine is not found within 2000 feet vertical distance

from the Annie camp; it climbs only to the line where *Populus Tremerloides* marks the upward limit of deciduous trees. The undergrowth is almost entirely a dwarf variety of salix.

Of flowers, I can speak only generally and briefly, They come up and bloom through the wasting snow about the 30th of May, and disappear about the end of August. For nine or ten weeks the mountains are a garden; the ground glorious with intense and contrasted color. Helianthus and rosa flanda, gentians, daisies, columbines, cowslips, larkspurs, blue bells, and I know not what else, combine to form a flora which if less gorgeous—cannot truly perhaps be called less beautiful—than that of the tropics. During three summers, industrious and careful collection was made; and I have in Ohio the material for five comprehensive herbariums, which material Dr. Geo. T. Engelmann of St. Louis has kindly consented to classify and name.

Epiphytes, Filices, and Graminea, are well represented at 12,000 feet; the latter largely—and our mountain men agree with the Savoyards in affirming that the highest pastures grow the sweetest and most nutritious grasses.

Of wild berries we have the currant, huckleberry, gooseberry, strawberry, and juniper.

On the 14th of June last—as early as the sunniest spot at 11,300 feet was clear of snow, we broke ground for an experimental garden. On 1st October, we made up the account with the following result: Radishes (roots) grew to be 5 in. long and ½ in. thick. Turnips to be ¾ in. in diameter. Maize (stalks) to be 3 in. high. Mexican beans, ditto. Peas 5 in. high, and blossomed; no fruit. Potato stems grew to be 6 in. high; longest diameter of tubers ¾ in. Beets (roots) 4 in. long and ⅛ in. thick. Kohlrabi and parsley did not come up. Nasturtiums grew to be 1½ in. high. Spinach and lettuce grew 3 in. high, and kept green for weeks after all the rest were dead.

Here, at the end of my time, though not at the end of material, I close this brief resumè of Upland life. It seems on looking back, an almost weird intercalation in the years. The attitude, the seclusion, the great mountains, the snow-shoe locomotion, the thin air, the entire absence of other than grateful warmth—all the surroundings of an Arctic residence—are like a dream, here at 700 feet over tide. To no one physical feature of our globe does man owe more than to its mountain ranges. Mineral treasures are the least of their contributions to his service. They are sources of life to all below. The increasingly larger knowledge of their relations to climate, to timber-line, to the growth of cultivated plants, to the well being of useful animals, to storm origin and distribution, to rain-fall and river supply—is constantly investing them with new titles of beneficence.

In all ages they have been nurseries of political and intellectual freedom for mankind. The civilization of Europe and America was born at the feet of the Himalaya with the Aryan race, two miles above the level of the sea. Wherever there is a land favored by nature with a mountain-chain, its inhabitants will make a history, and reflect in personal and national character, somewhat of "the strength of the hills".

I thank you for your attention.

OBJECTIONS TO MARKHAM'S NEW ROUTE TO THE POLE.

At the regular monthly meeting of the British Royal Geographical Society, of December 16th, 1878, Mr. Clements Markham read a paper on a proposed new route for Polar Exploration, *via* Franz Joseph Land, which elicited the following comments from Dr. Rae, a gold-medallist of the society, and well-known as an experienced Arctic traveler and student.

"We are told: First, that a high northern latitude might be attained, and valuable discoveries made along the western shores of Franz Joseph Land, which may be presumed "to be free from ice, as are those of Spitzbergen." Secondly, that the safest and best route by which to reach the west shores of Franz-Joseph Land is somewhere in the meridian of 44° E.—that is, nearly equidistant from Spitzbergen on the west and Novia Zemlia on the east.

Agreeing fully with the first of these opinions—namely, that a high northern latitude could be reached along the west shore of Franz Joseph Land—views not by any means new to me, as I brought them to the notice of the geographical section of the British Association at Dublin about four months ago—I am wholly at variance with the writer of the paper as to the best route by which to arrive at the desired locality.

He tells us that the best season to navigate icy seas, on the route he recommends, is towards the end of August and in September—at a time, in fact, when winter in high latitudes is about to set in—and mentions as his reasons for this choice the fact that one of several Arctic explorers, whom he names, reached latitude 78° 48′ in the meridian of 44°, leaving the audience to infer that there was something very wonderful in getting so far to the north; whereas many of the Arctic navigators of our own and other countries have gone much further North with sailing vessels in the meridian of Spitzbergen (in which Nordenskjold is made to say no useful end could be gained), by passing along its western shores.

Besides the lateness of the date at which the meridian of 44° is found to be navigable, there is another disadvantage in this route, which must be obvious to all thinking men in any way conversant with the subject.

The relative positions of Franz-Joseph Land, Spitzbergen, and Novia Zemlia, forming as they do three sides of a square, indicate that a passage through the inclosed space must in general be difficult and dangerous, because any strong winds from east, west, or south must press the ice-pack forcibly against one or other, and expose explorers to the same disaster that happened to the Austro-Hungarian expedition in 1873-4.

We know by the experience of centuries that the sea along the west coast of Spitzbergen is almost always navigable for two or more months, and I was extremely surprised that not a word was said about the expedition of Parry—the greatest of all Arctic navigators, living or dead—in 1827, half a century ago, to the north of Spitzbergen, when he got in his sledge boats, as high as 82° 45′ N., and, but for the untoward southerly drift of ice, would have reached a position farther north than that attained by a recent expedition up Smith's Sound.

A few extracts from Parry's narrative, every word of which bears the stamp of truth—a characteristic of this good and noble sailor—will explain, better than anything else can, the state of the ice in the high latitudes on the "meridian of Spitzbergen," and show how easily steamers of the present day could on that occasion have pushed their way among it.

With the sailing ship Hecla Parry reached latitude 81° 6′ N. about the middle of June, when they found "loose sailing ice to the northward"; the latitude reached in the meridian of 44° being 78° 48′ (or 138 miles less far north) on the 31st of August, as given in the paper read on Monday:

June 16, page 46.—Had a clear and extensive view of the Seven Islands, (latitude 80° 45′, longitude 21° E.), and saw land far beyond them to the eastward.

This far land probably forms one of the Franz-Joseph Land group. Finding no safe harbor near the Seven Islands, Parry ran southward to latitude 79° 55′, and secured his ship in Hecla Cove on June 20, having to saw a passage through the still unbroken ice in the bay.

When going northward in his boats, he tells us, at pages 99 to 101:

As usual, we were much annoyed by the numerous loose pieces over which we had to pass; but, a large portion of these being flat bay ice, we made tolerable progress. At 11 p. m. we could see nothing before us but this thin ice, much of which was not fit to bear the weight of our boats and provisions.

By our observation at noon we found to our great mortification that our latitude was 82° 36′ 52″, being less than five miles to the northward of our place on the 17th, since which we had traveled twelve miles in that direction.

July 22.—Our disappointment was great on finding that we were in latitude 82° 43′ N., or not quite four miles to the northward of yesterday's observation, instead of the ten or eleven miles we had traveled.

July 25.—So small was the ice now round us, that we were obliged to halt for the night at 2 a. m, being on the only piece of ice in sight in any direction on which we could venture to trust our boats. Such was the ice in latitude 82° 45′ north!

July 26.—Our latitude to-day was 82° 40′ 23″, only one mile north of our place at noon on the 21st, though we had estimated our distance made good at twenty-three miles—a loss of twenty-two miles by drift in five days!

No sailing vessel could have made headway against this southerly drift of the ice during calm or moderate weather, the most favorable for ice navigation; whilst there cannot be a doubt but a powerful steamer, such as those used at present as whalers and sealers from Peterhead and Dundee, would have found little difficulty in pushing through it.

Page 148.—The Hecla, in the beginning of June, sailed about in the neighborhood of the Seven Islands without obstruction, and before the close of July not a piece of ice could be seen from Little Table Island, latitude 80° 48′ N!

I may add, in conclusion, that before the middle of August, when we left the ice in our boats, a ship might have sailed in the latitude of 82°, almost without touching a piece of ice; and it was the general opinion that by the end of the

month it would probably have been no difficult matter to reach the parallel of 83°, about the meridian of the Seven Islands [which is the same as that of Spitzbergen].

Why the experience of the distinguished man from whose narrative I have given a few quotations was wholly ignored in the last paper read on Monday, and why the result of a voyage leading only to latitude 78° 48′, at so late a date as the end of August, was brought so prominently forward, I must leave your readers to infer. It is not far to seek.

When getting up the Smith Sound expedition, it was the fashion to assert that no land lay to the north of Spitzbergen, or, if there was any, it consisted only of small islands. I, on the contrary, from the time when I read Parry's narrative many years ago, believed that the great quantities of thin ice seen by him came from bays and inlets far north, which, being sheltered from pressure caused by winds and currents, break up later than the more exposed flows.

On looking over this narrative of Arctic work in 1827, I am surprised at the immense loads the men had to haul, and their very small rations of food. Including the officers as workers, each man had a weight of 268lb. to haul; but, excluding the officers, the loads were, with the sledges, 320lb. each; whilst the rations were only 10 oz. biscuit, 9 oz. pemmican, 1 oz. sweetened cocoa, and 1 gill rum per man per day. Parry says they were sometimes very hungry—no wonder!—and he occasionally issued 1 oz. biscuit and 1 oz. pemmican extra. They had carried with them provisions for seventy-one days.

Permit me to add that Mr. B. Leigh-Smith, in 1871, with his sailing yacht Sampson, after traversing 17 degrees of longitude to the north of Spitzbergen, in latitudes from 80° to 80° 30′ N., and making some valuable contributions to our geographical knowledge by new discoveries and corrections of positions, sailed northward, and on September 11 reached latitude 81° 25′, being 157 miles further north than the position (78° 48′) mentioned by Mr. C. Markham as having been attained by Payer, on August 31 in the same year, on the meridian of 44° east.

RELIEF FOR NORDENSKJOLD.

Dr. M. Lindemann, secretary of the Geographical Society of Bremen, writes to Capt. Howgate under date of January 11th, 1879, that this year an expedition will be sent out by an honorary member of the Society, Mr. Sibiriakoff, by way of the Suez Canal and Indián Ocean, to Bherings Strait—in search of Nordenskjold. The steamer of 350 tons burden, is to be built at Malmö, and will be commanded by Mr. Henry Sengstacke, an excellent seaman of great Arctic experience, who was first officer of the Germania in 1869-70. It is expected that a small scientific corps will accompany this expedition.

Besides the vessel now fitting out at the expense of M. Sibiriakoff for the rescue of Professor Nordenskjold, and James Gordon Bennetts' ship, the Jeannette, a Russian man-of-war is to proceed immediately with assistance to the

Swedish expedition. Orders have been transmitted by the Russian Admiralty for the Abrek, of the Imperial Russian Navy, to go to Behring's Straits in search of the explorers. The Abrek will call at Kamtschatka for Esquimaux, with their sledges and dogs, and then push northward.

The following letter has been received from M. Sibiriakoff:

"I am very glad to hear the Jeannette will be sent through the Behring's Straits, and that she will render every assistance in her power to Professor Nordenskjold. I will send my steamer, the Nordenskjold, which will be ready on the 10th of May next, through Behring's Straits, for the mouth of the Lena. I hope, however, that the American vessel will pass the Straits as soon as they are practicable, and will render this assistance unnecessary. I shall try now to rescue Nordenskjold by land."

CHEMISTRY.

CHEMISTRY IN THE ARTS.

BY PROF. G. E. PATRICK, UNIVERSITY OF KANSAS.

(*Extracts.*)

In the iron industry chemical science has of late years played an important role; without it the iron master would have been like the captain of a rudderless vessel; he might have pushed blindly forward, but would have been without means to guide his course.

Although chemistry has lent her indispensable aid and guidance to the whole iron industry, it is in the art of steel making that she has done especial service and won her highest honors. Analysis long ago established the rule, that wrought iron to be of good quality must not contain more than .5% of carbon; that a good steel may contain .5 to 2% of that element and that a cast-iron may hold any amount between 2, and 6%, and be of fair quality; it also showed that it is just this varying amount of carbon that determines the leading properties of a piece of iron—determines whether it shall be called *cast iron*, *wrought iron*, *or steel.*

Analysis showed steel to be a mean between the two extremes, cast and wrought-iron, as regards their per centage of carbon. Now, the old method of making steel—a very good one for the sleepy days of twenty years ago, young America would say, but rather slow for these—was to take bars of wrought-iron, pack them in powdered charcoal, and expose them, thus encased, to a furnace heat for a time varying between ten and twenty days; they were then taken out as steel, the carbon having gradually entered the bars and forming a chemical union with the iron. The time of heating in this charcoal bath depended upon the size of the bars, but even this was regulated largely by guess; there was nothing in the entire process, that in the most distant manner resembled scientific accuracy. But now, how wonderful the transformation! When was a grander e'er

beheld by mortal eyes or fairies'! The magic wand of science is waved and Ariel is at work. The Prospero that waved the wand, is Henry Bessemer; behold the results of his magic! They used to take 20 days for making steel; he made it in 20 minutes. They used to make steel in bars of a few pounds weight; he made with ease six tons in a single mass. They used to "guess" like the Yankee or "reckon" like the Southerner, that "maybe that charge of steel would likely have about enough carbon in it, in a day or two more, perhaps"; he could tell within five seconds when his steel was made, and within one tenth of one per cent. how much carbon it contained. In short, his method is a marvel of scientific precision.

(Here follows a description of the Bessemer process and reference to some of the results of the invention.)

Nowhere among all the chemico-industrial pursuits is there a better example of a thriving industry that has grown out of purely theoretical studies, than is found in the arts of dyeing and printing. I refer to the discovery—perhaps better the *creation*—of the host of brilliant colors that are now derived from coal-tar, and known under the general names of the aniline and the anthracene colors. In the history of these two groups, aniline and anthracene, with all their derivatives, is a lesson in characters so plain that he who runs may read; it is at once a lesson and a rebuke to the narrow-minded "utilitarian;" to him who is forever asking, "Of what practical *use* is all this study, all this scientific investigation?" and who speaks of the search for truth in the fields of abstract, unapplied knowledge, only to sneer at and denounce it. To him, if his brain be not too barren a soil for new thoughts to grow in, the history of these beautiful and useful compounds may suggest one or two pertinent queries: Who can tell what is really "practical" and "useful" knowledge? If this or that particular island of knowledge, in the great sea of ignorance, be of no great "use" to us, who can tell but it may be, to those who come after, the very island to save them from shipwreck?

Aniline has been known to chemists since 1826, when it was discovered among the products of the destructive distillation of indigo; it was subsequently made in small amounts by the decomposition of several organic substances; but there was no means known of making it in quantity until 1842, when M. Zinin prepared it in a manner that may be called *chemically beautiful*, by the action of nascent hydrogen upon nitro-bengol, a substance easily made from bengol (or benzin) which, in its turn, can be obtained in abundance by the distillation of ordinary coal-tar. Zinin rendered it possible to make aniline in great quantities, for coal-tar was then not only a valueless waste-product, but a positive nuisance in many cities of Europe. But at that time, aniline was in no demand, as its value was not yet known; and it remained for some years simply a chemical curiosity—one of the thousands of organic bodies brought into the world by synthetic chemistry. But a chemical curiosity in these latter days finds little rest in the chemist's hands; he straightway goes to work with oxidizing or reducing agents to bring forth from it, if may be, some new and strange offspring with

which his name may be coupled, and by which it shall be borne to posterity. It is this unceasing activity, this thirst for new conquests, this desire to pry further into things than all other men have done, that leads to nearly all discoveries, as it did to that of the aniline dyes.

(Here follows an account of the discovery of one or two of the aniline colors; then the artificial formation of alizarine from anthracene; then a few words about the beauty of all these colors; then the following words to close the subject:)

Right here, the afore-mentioned utilitarian might break in with "Pshaw! that's no discovery worth speaking of; only a few pretty colors, really good for nothing anyway." But here is another view which the utilitarian loses. Does not the whole world agree with the sage of Concord, that "If eyes were made for seeing, then beauty is its own excuse for being," and with that other greater genius, that "a thing of beauty is a joy forever?"

* * * * * * * * *

The age of the alchemists is passed, and their profoundest thoughts upon the nature of matter and force are to us but the dreams of children; still, within the last few months, there has come to us from over the sea an announcement that recalls one of those same dreams of the alchemists—the dream of the transmutation of metals. The announcement is not, it is true, of the transmutation of a base metal into gold, but of a base earth, which we most commonly meet in ordinary clay, into something far more precious than gold; namely, the precious stones *sapphire* and *ruby*. The successful alchemists who accomplished this brilliant transmutation were two French chemists, Fremy and Feil; they did not, however, follow the blind empirical methods of ancient alchemy, but rather endeavored to find out and follow the methods of nature.

How has nature in her great laboratory, filled in general with so much coarse rubbish, succeeded in making, amid all this worthless stuff, those brilliant gems that sparkle here and there on the bosom of dear old Mother Earth? This *was* nature's secret, but it is her's no longer. By studying these gems their compositions occur at once, and the properties of their constituents. Chemists found out long ago that nature made her jewels out of the most common and homely material—mainly out of alumina, adding in some cases silica, or some of the metallic oxides; and further, that in the transformation of these earthy materials to their present brilliant forms, she has employed intense heat. For years it has been man's endeavor to imitate, in his laboratory, the methods of nature in her's; but, until a few months ago, his success has only been partial.

(Then follows the description of the method by which the two chemists referred to above have succeeded in making sapphires and rubies, identical in hardness, color and lustre with the natural minerals.)

The other achievement referred to, is that of the artificial preparation of vanilline, the aromatic principle of the vanilla bean, from a vegetable substance extracted from pine wood. This was accomplished in 1874 by two German chemists, Tiemann and Hoormann. It was the reward of months, perhaps

years, spent in the study of the composition, structure and properties of a substance which, by any sane person, would have been set down as a most unpromising subject to work upon with the hope of producing from it anything of use or value to mankind. But who can tell which sea-shell bears a pearl, which rose shall blossom, which shall die?

Vanilline, or, in other words, extract of vanilla, is now prepared on a manufacturing scale, from so humble and unpretentious a substance as pine shavings—a fact that should serve as a bond of fellowship and union between the carpenter and the cook!

PROFESSOR NICHOLS ON LOCKYER'S NEW THEORY.

We say new "theory" rather than new "discovery," because now that we have a semi authoritative statement concerning what Mr. Lockyer in his brief note to the Paris Academy asserted that he had "proved," it appears to be nothing more than a plausible hypothesis based upon his spectroscopic observations. The paper which had been heralded in so "sensational" a manner by this over-confident note, and by the extravagant articles on the subject in the *Daily Telegraph* and other London newspapers, was read to the Royal Society on the 12th of December. We expected to see it printed in *Nature* for December 19th, but found instead only the following brief note: "We have not received from the Royal Society the paper read last Thursday by Mr. Lockyer, in which he brought forward facts indicating the compound nature of the chemical elements. In the mean time, the following article from yesterday's *Times* may be of interest; it is evidently written by a chemist who was present when the paper was read." *Nature* for December 26th has since come to hand, but with no further reference to the paper. From the *Times*' article, however, which is thus indirectly endorsed by Mr. Lockyer, we are able to glean what were probably the main points of the paper.

To state the substance of it in the briefest possible manner, Mr. Lockyer, in the course of a long series of comparisons of the spectra of the metals with the solar spectrum, observed that certain lines re-appeared with singular persistency in the spectra, not only of one, but of several so-called elementary substances. These lines have been generally attributed to the presence of impurities in the substances under examination, but the scrupulous precautions observed to exclude every possible trace of contamination, and the continued recurrence of the same lines under varied circumstances, suggest the belief that they are not accidental, but essential; or, in Lockyer's own words, "the hypothesis that identical lines in different spectra are due to impurities is not sufficient." It seems a logical deduction from this that the metals in question have some constituent in common, and are therefore not elementary. Mr. Lockyer accepts this inference from his observations as if it "proved" his theory; but we need hardly say that he has "proved" nothing whatever. The most that can be conceded is that the

conclusions he has reached, and which are said to be "the result of a hundred thousand spectroscopic observations, which have taken six months to summarize," favor the supposition that the so-called elements are compound; that is, no other theory yet propounded accounts so well for the facts in the case as this does. But it is a theory, after all, and nothing but a theory; and it must be subjected to the same ordeal that all theories have to endure. It is perfectly satisfactory to its author, as new theories always are, but it must now run the gauntlet of scientific men with whom it is not a pet child, and who will show it no mercy if it cannot stand the tests they apply to it. How it will come out of the trial remains to be seen. Indeed, until we have the paper itself, and not a mere newspaper abstract of it, no scientific man will pass final judgment upon it. A friend of ours asked one of the most eminent spectroscopists in the country his opinion of it, a few days ago, and he replied that he had nothing to say about it while he had only the newspaper reports of it. The scientific world is waiting for "official" statements on the subject, and we trust it will not have to wait much longer.—*Boston Journal of Chemistry.*

ANTHROPOLOGY.

REPORT ON ANTHROPOLOGICAL SOCIETIES AND INSTRUCTION IN ANTHROPOLOGY

At the International Congress of Anthropological Sciences, at Paris, Aug. 16-18, *by Dr. Thulie.*

TRANSLATED BY PROFESSOR OTIS F. MASON, FROM REVUE D'ANTHROPOLOGIE.*

The end of the nineteenth century seems to have been appointed to perfect that which was commenced by the great geniuses of the eighteenth, and also to give existence and form to some of their aspirations.

Linnæus, who assigned to man a place in his zoölogical classification, Buffon, who wrote the natural history of man, Blumenbach, who established the divisions of the human race upon craniology, are the fathers of anthropology.

In 1800, a few naturalists and a few physicians founded the "*Societe des observateurs de l'homme.*" This society, following the programme drawn up by Jauffret, its general secretary, proposed principally to direct the researches of travelers. But the wars of the Empire, cutting off all commerce and foreign travel, arrested this endeavor. The society of observers of man abandoned natural history to devote themselves to historic ethnology and to philosophy. After a short while it was invaded by the philhellenists, and became merged, after three years, with the "*Societe philanthropique.*"

In 1838, this effort fell into complete desuetude, when the philanthropists founded at London the "Society for the protection of Aborigines." England

*Expressly for the KANSAS CITY REVIEW.

having abolished slavery, this question began to occupy political circles in France. Hodgkin, one of the most zealous members of the English society, came to Paris to make proselytes, but he could not succeed in persuading the egotistical and complacent society of the reign of Louis Philippe to partake of his aspirations. His mission, however, was not altogether fruitless for science, and William Edwards, by his "*Etude sur les caracteres physiologiques des races humaines considerees dans leur rapports avec l'histoire*," founded, in 1839, the Ethnological Society of Paris.

Since the beginning of the century studies upon man have multiplied, and quite a number of savants have directed their minds toward this interesting, yet neglected portion of natural history. The "*Societe ethnologique*" had its origin under the most favorable conditions. The works of Blumenbach had just appeared, Prichard, Desmoulins, Vizey, Bory de Saint Vincent, Gerdy, D'Orbigny, Brocalet and Lesson had published important memoirs; Morton had brought out his *Crania Americana*; craniological museums were formed; finally, linguistics, that part of anthropology so useful, had just organized into a serious and productive science. When the first volume of "*Memoires de la Societe ethnologique de Paris*" appeared, the learned world were struck with the utility of its labors and researches. An ethnological society was founded in London in 1844, and a short time afterward another in the city of New York, adopting entire the programme of the Paris society.

Flourens, a member of the Ethnological Society and Professor of human anatomy at the museum commenced from that time to set forth in his course of lectures the history of the races of men; Serres, who succeeded him, likewise added as a sub title to his course: "The Anatomy and Natural History of Man." Later, this chair took the name of "*Chaire de Anthropologie*;" it is brilliantly occupied to-day by M. de Quatrefages. It was only in 1865 that a chair of anthropology was founded in Florence; since then three have been established in Germany, and one in Moscow.

Serres founded an anthropological gallery. There had been previously private collections in Germany, Holland, England, and in the United States, but the first public gallery was that of the museum. There are others to-day at Florence, Berlin, Moscow, St. Petersburg, Brussels, Philadelphia, Washington, etc.

It was the "*Societe de Ethnologie*" of Paris which gave to the word anthropology the sense which it bears to-day. But, in truth, the question of slavery absorbed all the activity of the body. The discussion of the distinctive characters of the white and the black race was merely a controversy upon slavery in spite of the efforts of naturalists and physicians, and the society abandoned the purely scientific domain for the passionate discussion of a social question. This was in 1847. In 1848 the society was so given up to this subject that when the Republic abolished slavery, it did not indeed dissolve, but did cease to meet, as if the grand object of its labors had been attained.

Now, the study of man is making rapid progress. In England, Sweden,

Denmark and Switzerland researches and publications are multiplied. In America Samuel Morton brought to bear upon his anthropological researches, geology, palæontology, archæology, general zoölogy, zoölogical geography, and medical geography. He thus prepared the way for that brilliant American school which was broken up by the War of Secession.

But no society yet existed grouping together all the sciences which concur in the natural history of man, from comparative anatomy to the study of customs, from geology to linguistics. It was in 1859 that the "*Societe de Anthropologie de Paris*" was founded. This society has considerably enlarged the former programme of ethnology, in making its appeal to a large number of sciences, by the aid of which it has constituted several new branches, such as general, pre-historic, zoölogic and linguistic anthropology.

Craniology has become purely scientific since this epoch. Enlarging also considerably the ancient programme, and no longer considering ethnological descriptions more than a branch of anthropology, the society has regarded it necessary to take a more general title, that is: "*Societe anthropolog que*".

On the first appearance of the Bulletin of the *Societe* its title was adopted abroad. In 1861 a congress of German savants meeting at Göttingen assumed the name of anthropological congress, and at a reunion in 1865 founded the *Archiv fur anthropologie.*

In 1863 "*The Anthropological Society*" was founded at London, declaring itself to be the daughter of the Paris society. It had to maintain a long and animated conflict with the old "Ethnological Society", which desired to remain faithful to the former programme of ethnology, but which wound up by walking in the new path, and thus permitted the fusion of two societies.

Since 1863, anthropological societies have been founded at Manchester, Berlin, Vienna, Florence, Madrid, Havana, etc. A special and very active section under the leadership of Professor Bogdanoff has been constituted in the *Societe imperiale des Amis des Sciences Naturelles*, in Moscow. A special section has also been formed in the Academy of Cracovia.

If all countries which contain distinguished anthropologists have not centers of action and developement, the international Congresses furnish them a bond of union with foreign savants and facilitate their study. It is to Gabriel de Mortillet that we owe the fruitful idea of these Congresses. In the session of the Society of Natural Sciences held at Spezzia in 1865 under the presidency of Professor Capellini, M. de Mortillet proposed to the antehistoric section the foundation of an international palæorthnological Congress. This proposition was adopted, and in 1867 the Congress took the name, "*Congress d'Anthropologie et d' Archeologie prehistorique.*"

I should mention, before closing this very incomplete report, a foundation which dates back no longer than two years, and which has already produced happy results in the diffusion of anthropological science. I speak of the Anthropological Institute of Paris, founded by M. Broca, to whom our science is so much indebted. You may visit the building of this Institute, where are united a museum,

a library, and a laboratory. Owing to the energy of the *Société anthropologique,* to the activity of our devoted president, to the generous aid of the city of Paris, and of the department of the Seine, we have been able to found the following six courses:

1. Anatomical Anthropology.
2. Biological Anthropology.
3. Ethnic Anthropology.
4. Prehistoric Anthropology.
5. Linguistic Anthropology.
6. Demography and Medical Geography.

It is thus that we hope to expand the knowledge so precious for the future of humanity; it is thus that we wish to know concerning man, what he his, and whence he came, and to be able to predict, without being a prophet, what the new philosophy and scientific sociology will bring out of the labors of anthropologists.

(By an unfortunate oversight, Dr. Thulie has failed to speak of the Wilkes expedition and the Smithsonian Institution, the former of which embraced linguistics in the programme of ethnology, and the latter from its foundation brought within the scope of the study of man all that is now included in the course of lectures of the "*Ecole d' Anthropologie*"—O. T. M.)

THE ORIGIN OF METALLURGY--THE BRONZE AGE.

IV.

We must now speak of the industries of the bronze age, of which the several strata compared with each other have revealed the existence, nature, processes and relative epochs; among them there were some indigenous. Undoubtedly the men of those ancient times must have built their own houses, which were made of wood, after the time they left the caves. Those they erected on solid ground have disappeared without leaving any traces behind; and if the houses of the lakes have been destroyed, at least the piles upon which they were built still remain. Those of the epochs anterior to metal, were nearer the banks and did not project so far out of the water. The others were built beyond the first, and in Savoy, have a greater jutting out, by which they can easily be recognized. The pieces of wood resting on the piles and forming the flooring, were fastened together by means of tenons and mortises; which shows clearly that they could with hatchets and chisels of stone, cut and shape large pieces of wood. Planks were made by splitting the trunks of trees; the stone saws are only several inches long, while those of bronze are not a foot; they could only be used on light work. Of these several specimens have been extracted from the lakes of Savoy, such as spoons, tool handles, spindle shanks, sabots, a porringer, and part of a bucket.

The great number of bobbins of baked clay, which are called by the Italians *fusaioles*, indicate that the custom of spinning and weaving was then extant; there were many discussions as to the use of those small cones bored through their *axis*, but there is now no more doubt, since a complete spindle was found in the

lake of Bourget. We have ourselves seen pieces of wood worn out in the holes of many bobbins, found in Troy by Dr. Schliemann.

These very things are still used throughout the Middle and West of Europe. They could obtain very delicate threads with these spindles of wood and clay, as is evident from the smallness of the eye of several bronze needles. The finest textures have been destroyed under water as well as under ground, but a few specimens of the coarser textures, meshes of nets, thread, cord, and bundles of beaten flax, have been preserved in the mud of the palafittes of Bourget. The flax then used had small leaves, and differed from the kind now cultivated. To the weaving we may add the fabrication of baskets of rushes, reeds and osier, and the making of fishermen's snares, and the large hurdles which were used to fortify the walls of houses in supporting the roof.

The local industry which has left the most traces in the strata of bronze, except the treasures and foundries, is the moulding of argil. We have already noticed that the potteries of the period of stone were not baked, but merely dried in the sun. The art of baking was introduced during the age of polished stone, and continued to be improved during the entire age of bronze. Still the most *ancient* vases of that period were badly baked, very often burnt on one side and raw on the other; it would appear that these potteries were cooked in the open fire and not under a reverberatory furnace, which however was the case. The dishes and plates showed few signs of the fire. It was only toward the end of the bronze age when iron was already beginning to supplant it, that the potter's wheel was used. As simple as was this revolving machine, it afforded certain facilities of fabrication which were formerly unknown. The progress seems to have been made only after the appearance of iron. The various kinds of vases fabricated by processes so elementary were astonishing. Some were used for carrying water, others for preserving and cooking food. There were also some drinking vases, among which are the rhytons, and lamps in imitation of the old Greek and Roman lamps, rings of clay used as rests for small-cased vases and perforated cheese molds as in our own day, which shows that men in olden times were fond of the product of the dairy.

With regard to the ornamentation of pottery, it has received special attention from scientists, for it has afforded, during the bronze age, transformations useful in chronology, which are found on contemporaneous bronzes. The rough pottery of the stone age was ornamented by straight lines engraved thereon with zigzags more or less irregular. In course of time these lines became more regular, and are drawn parallel by means of burins with several points, consequently the figures are more accurately made. The use of concentric rings may be noticed throughout Europe during the bronze epochs. The plain cross, the multiple and four pointed cross, the encircled cross in shape of a wheel, stars and triangles appear regularly in successive years.

The figures are no longer merely engraved with pointed instruments, they are also impressed with stamps of metal, clay or stone. The Swastika (a species of cross with curved arms) and the meandre, which is made up of a succession of

swastika, are to be met with especially during the period of transition from bronze to iron. During the first iron age, and further on in historic times, this figure was popular with the people of the Aryan race, and appeared in the west after the bronze era. It was about this time that the potters began to paint certain vases with red or yellow ochre or with that black which afterward became peculiar to Grecian ceramics. Lastly, the inhabitants of the lacustrial dwellings used a sort of decoration which was, however, afterward abandoned. On the dark bottom of some vases of fine clay, they fastened thin sheets of pewter cut in narrow strips, with rosin, and formed a variety of beautiful designs. Metallic ornamentation, no doubt, had its origin in the West. The industry of bronze characterizes the period now under consideration. In speaking of the foundries we made little mention of the material of the founders; so far there has been found but a small piece of mineral brass, and nowhere in Europe has a furnace or any instrument for extracting ore been found. We may, therefore, be justified in supposing that the metal was brought from the vicinity in its rough state, or already molded. In fact, ingots of bronze are found wherever the founders were stationed, they are in the form of small squares, or like hammers having a hole in the center to hang them up by.

We should recollect that no pure copper* is found, very little tin, whilst throughout Europe bronze is of uniform composition. The following is obtained from the analysis made by Messrs. Wibel and Fellenberg and by M. Damour; the proportion of tin is about ten per cent., but there are exceptions as in cold chisels and one or two other objects of hard bronze, which contain as much as a quarter of tin to three-quarters copper. This uniformity of composition of alloy throughout Europe, proves the unity of its origin and importation, but of this further on.

Researches have brought to light besides ingots and refuse castings of metal, a number of molds made of schist, steaschist, freestone, baked clay and bronze. Many of these have figures on two or four sides, and on some there are several figures along side of each other. The crucibles are made of earth mixed with broken quartz and often contain metal. Some have the shape of the laboratory crucible, while others are like cups with handles. All these receptacles could contain but a small quantity of metal; their form and dimensions are pretty much the same throughout Europe.

The articles, made by means so rudimentary, may be divided into three classes, viz., tools and utensils, arms and ornaments. Among the first may be included the hatchets first made similar to stone hatchets, with holes for the purpose of inserting a handle which was fastened in the socket with a cord. We are able, considering the superposition of the layers in the lacustrial habitations and stations to follow these transformations, and determine their relative epochs. Scissors, knives, chisels, sickles, handles, saws, gimlets, jewelers' pincers, are the tools usually found in all the strata. We may also add razors, which were first made of hard stone, then of bronze, which were finally supplanted by iron ones.

* It appears that in Hungary and Greece many specimens have been noted.

These instruments were not of the shape which they are to-day; they were semicircular with the edge on the side of the curve. Then there were some double ones edged on both sides of their diameter, and fastened to an ornamented handle, forming together but one piece. The different razors will enable us to ascertain the relative age of the strata in which they are found.

Was the horse domesticated at the appearance of bronze? It is probable that he was tamed during the period of polished stone, and yet it is possible he may have been long before. If he was then only in a wild state, it would be difficult to explain the quantity of bones which are found in certain places of the first period of stone, as in Polutré. This station, which is not far from the Saone river, above Macon, contains, it is said, the skeletons of 100,000 horses, most of them young, which may have served as food for the inhabitants of the place.

Be it as it may, the bronze bits found among the piles of the lake of Briene and afterward in France, bear witness to the fact that the horse was already subdued. The oldest of these bits are made of two movable pieces one above the other in center of the animal's mouth. Soon after the four pieces are movable, although each of the exterior pieces has a cross-piece through the middle, and thus forming two equal branches. This second class of bit characterizes the terramares, and had been learnedly studied by Count Gozzadina. It seems that in the stone age the horse half tamed was used as food for man, that being subdued in the second period he was mounted and perhaps harnessed, and, finally, at least in Italy, at the end of the bronze age he became tame enough to be guided about with a string. Arms do not form the least interesting portion of our bronze collection; they perhaps better than anything else enable us to determine the successive phases of this metal. They are found everywhere in Europe and Asia, but they should not be attributed to Gaul as has been done. The palafittes, foundries and treasures have given them their definitive place in the bronze age, and if they appear only in small quantities, owing to the scarcity of the metal, they soon become so abundant as to supplant entirely the arms of stone. Later on iron is found in many places in Europe, but in small quantities and is regarded as an object of luxury. It soon after exercises in its turn an appreciable influence on bronze arms, the form and size of which are modified. Finally, bronze is entirely abandoned. The blade of the swords and poignards of the early part of the bronze age was of metal, but not the handles. Often in these primitive arms, the tongue of the blade does not go far into the handle; it is broad, short and pierced with two or more holes through which the iron rivets pass. Afterward metal handles are made, either without a guard or one in the shape of a cross. Switzerland, Denmark and Sweden have produced swords with antennæ, that is to say, with two prongs jutting out and curved at the end of the handle above the hand. The long swords, the length of which is often two feet and a half, which are to be found throughout the West, had handles made of horn, wood and bone, and resembled the iron sword which soon replaced them. In France there have been discovered 650 swords and poignards of bronze, in Switzerland 86; in Sweden 480, and they are generally found throughout Europe.

The dolmens and sepulchral caves of Lauguedoc and Vivarais, the palafittes of the lakes of Neufchatel and Varesa, have produced arrow heads similar to those of silex which had preceded them, and used up to the transition from stone to metal; they characterize this epoch as the razor characterizes the transition of bronze to iron. These small pieces of metal were flat, being fastened in the shaft with a cord.

It is during the second period of the bronze age that armor is made of metal, as helmets, shields and cuirasses; prior to this time they are made of leather and wood. This is the period that M. de Mortillet designated by the term "Chandronnerie," the art of enlarging and shaping iron under the hammer being added to that of molding. This method was used not only in the manufacture of armory, but also to the edging of arms and tools and of a multitude of ornamental objects.

The latter outnumbered the former, especially when metal was rare; pins are picked up by hundreds. The foundry of Larnaud has furnished 214 bracelets, the lake of Bourget more than 600, and a great number have been found in the dolmens of Central Europe. The oldest are oval, the latest round; those which date from the bronze epoch are open, but are closed as soon as the industry of iron is general. The large collar rings, called torques by the Romans, are not found until after the appearance of the latter metal; finger rings are scarce throughout Europe, but plain rings, necklaces and buckles are everywhere found in large quantities; there are besides these many other ornaments or amulets, such as earrings, fillets, &c., which evidently have a symbolic character. Let us here note that these symbolic figures are about the only signs of any religion during the bronze epoch. We may add that they are not indigenous, but are doubtless derived from Asia, as also the cithern which is made of hollow reeds with nine or twelve rings fastened at the end of a stalk of wood. There are several in existence, two of which were found in France, three in the lake of Bourget, the others at Christiana, at Wladimir and Yavorlan. These citherns are not like those of Egypt, but like those of the priests of Buddha, who themselves hold them of an ancient Aryan tradition.—*Van Nostrand's Magazine.*

In answer to a request of Dr. Fischer, Mr. W. H. Holmes, the distinguished artist of the Hayden Survey, sends us the following note:

"The most extensive deposits of obsidian yet known in this country were found last summer in the Yellowstone Park. Arrow points and flakes of obsidian had previously been collected in the various valleys about the sources of the Missouri and Snake rivers, but the source of supply was unknown. Near the head of the middle fork of Gardiner's River, in the northwestern part of the Park, deposits of this rock nearly 600 feet in thickness and of unknown horizontal extent were found. In making examinations of the strata at this point I noticed the occurrence of great numbers of flakes of obsidian. These are most plentiful along an old Indian trail, and after a careful search nearly a dozen more or less perfect implements were obtained."—*Harper's Monthly.*

GEOLOGY.

PROF. J. D. DANA'S TABLE OF GEOLOGICAL FORMATIONS. 1878.

Systems of Ages.		Groups of Periods.	Formation of Epochs.
Age of Man.		20 Quaternary.	20. Quaternary.
Age of Mammals.		19 Tertiary.	19c. Pliocene. 19b. Miocene. 19a. Eocene.
Reptilian Age.		18 Cretaceous.	18c. Upper Cretaceous. 18b. Middle Cretaceous. 18a. Lower Cretaceous.
		17 Jurassic.	17. Jurassic.
		16 Triassic.	16. Triassic.
Carboniferous.		15 Permian.	15. Permian.
		14 Carboniferous.	14c. Upper Coal Measures. 14b. Lower " " 14a. Millstone Grit.
		13 Subcarboniferous.	13b. Upper Subcarboniferous. 13a. Lower "
Devonian or Age of Fishes.		12 Catskill.	12 Catskill.
		11 Chemung.	11b. Chemung. 11a. Portage.
		10 Hamilton.	10c. Genesee. 10b. Hamilton. 10a. Marcellus.
		9 Corniferous.	9c. Corniferous. 9b. Schoharie. 9a. Canda Galli.
Silurian or Age of Invertebrates.	Upper Silurian.	8 Oriskany.	8. Oriskany.
		7 Lower Helderberg.	7. Lower Helderberg.
		6 Salina.	6. Salina.
		5 Niagara.	5c. Niagara. 5b. Clinton. 5a. Medina.
	Lower Silurian.	4 Trenton.	4c. Cincinnati. 4b. Utica. 4a. Trenton.
		3 Canadian.	3c. Chazy. 3b. Quebec. 3a. Calciferous.
		2 Primordial or Cambrian.	2b. Pottsdam. 2a. Acadian.
		1 Archæan.	1b. Huronian. 1a. Laurentian.

TABLE OF THE GEOLOGICAL FORMATIONS, ARRANGED FOR MAC FARLANE'S GEOLOGICAL RAILWAY GUIDE.

BY PROF. T. STERRY HUNT, LL. D., F. R. S.

Ages.	Groups.	American Formations.
Cenozoic.	20. Quaternary.	20. Recent.
	19. Tertiary.	19c. Pliocene. 19b. Miocene. 19a. Eocene.
Mesozoic.	18. Cretaceous. 17. Jurassic. 16. Triassic.	18. Cretaceous. 17. New Red Sandstone. 16. " " "
Palæozoic.	15. 14. 13. Carboniferous.	15. Permo-Carboniferous. 14. Coal Measures. 13b. Mississippi (carb. Limestone). 13a. Waverly or Bonaventure.
	8–12. Erian or Devonian.	12. Catskill. 11. Chemung and Portage. 10. Hamilton, including Genesee and Marcellus. 9. Corniferous or Upper Helderberg. 8. Oriskany.
	5–7. Silurian.	7. Lower Helderberg. 6. Onondaga or Salina. 5c. Niagara including Guelph. 5b. Clinton. 5a. Medina. 5a. Oneida.
	4. Upper Cambrian or Siluro-Cambrian.	4c. Loraine. 4b. Utica. 4a. Trenton.
	3. Middle Cambrian.	3c. Chazy. 3b. Levis, (Tremadoc and Areing). 3a. Calciferous,
	2. Lower Cambrian.	2d. Potsdam. 2c. Sillery. 2b. Acadian, (Menevian). 2a. Lower Taconic.
Eozoic.	1. Primary or Crystalline.	1d. Montalban. 1c. Norian or Labrador. 1b. Huronian. 1a. Laurentian.

REMARKS ON HUNT'S AND DANA'S SECTIONS.

BY PROFESSOR G. C. BROADHEAD, PLEASANT HILL, MISSOURI.

Critically comparing these geological sections, pages 664-5 in some respects we find both are good. We like Dana's term Archæan better than Azoic or Eozoic. Newberry and Hitchcock, with Hunt, have adopted the term Eozoic. Archæan signifies ancient, Eozoic the period of the first dawn of life. There may be a previous life period but as yet unknown, and for this reason therefore it has been well to discard the term Azoic, for it did not convey the full truth. Neither do we entirely like the term "Primary" for it may not include the oldest. But this is not so important. The term "Taconic" used first by Emmons, and since by Hunt, is not adopted by many Geologists, for of the exact or proper position of these rocks there yet remains doubt.

Mr. MacFarlane divides the Quebec into the lowest, (1) Sillery next (2) Levis and (3) Lauzon and all above the Potsdam. Dr Hunt places the Sillery below the Potsdam. Dana (1874) quotes Sir William Logan who separated the Lauzon from the upper part of the Levis. He also added the Sillery sandstone found near Quebec and supposed it to rest above these; but the section was afterward found to be inverted and the Sillery to be below, still the exact Geological position of the Sillery has not been settled by the Canadian Geologists.

Dr. Hunt used the term "Cambrian" in a more extensive relation than Dana and some other geologists. In this he follows Sedgwick the English geologist who first used the term, applying it to all those formations between the Archæan and upper Silurian. Hunt only terms the latter "Silurian." In his Geological essays he treats of these formations in detail. He claims that Sedgwick fully described them and applied the term Cambrian before Sir R. Murchison enunciated his Silurian system, that a great wrong was done him by Murchison, who suppressed his names and used instead the term "Silurian" and that Silurian is only corretly applied to the upper Silurian. Opposed to this we find the English Geologists have since adhered to Murchison's nomenclature although the priority of the name Cambrian may be due to Sedgwick, Hunt, Shaler and a few others have adopted and use the term Cambrian in their descriptions of American Geology, but Dana, Newbery, Hall, Hayden, Safford, Selwyn and most of the American Geologists use the term Silurian as adopted by Murchison. As used by Dana it has become a household name in American Geology and as all students understand his nomenclature, we see no good reason for a change, even though a long time since, an act of injustice may have been done to Sedgwick in a mere name.

To the Devonian Dr. Hunt also applies the general term Erian. In America this may be a good name, as rocks of this age are well developed near Lake Erie.

In this connection we notice an important paper by Dr. J. S. Newberry read before the National Academy of Science, and published in *Science News*, Salem, Massachusetts, December 1st, 1878.

The most important difference is where Dana places the Oriskany at top of the upper Silurian. Hunt puts the Oriskany at the base of the Devonian. In this he is supported by Newberry, Hall, Vernuil and Lyell. Dr. Newberry says that between the Helderberg and Oriskany there is as strongly marked physical break as is found in the Series, and in Ohio the two formations are distinctly unconformable, and that in Canada the most characteristic fossils of the Oriskany, *Spirifer arenosus* and *Rensselaeria ovoides*, are mingled with Corniferous species.

Observations of Geologists in Brazil also go to show that the Oriskany should be placed in the Devonian.

Dr. Newberry says that the carboniferous really begins with the Portage and includes the Chemung and Catskill. The Portage Sandstones show ripple marks and sun cracks indicative of exposure to the air, and the same evidence existing in the Chemung in Pennsylvania, also shows that a subsidence was in progress. This subsidence culminated in the spread of the carboniferous sea and deposits in the valley of the Mississippi of carboniferous limestones in the deeper seas. The fossils tell the same story as those of the Chemung and are more Carboniferous than Devonian.

Another point to which Dr. Newberry refers is the disputed age of the Lignitic or Laramie group of Colorado. Professor Lesquereux our ablest Palæo-botanist places this group among the Tertiary, based on a careful study of its extensive flora. In this view he has been supported by Professor Hayden. All of our other Geologists and Palæontologists assign it to the age of the Cretaceous. They base their reasons on a study of the fauna—Cope and others on the Vertebrata. On a recent map of Hayden, it is marked Post-cretaceous. Dr. Newberry after the most careful study of the plants and also of all that had been written on the subject, said he failed to find satisfactory evidence of the Tertiary character of the flora. He also states the unconformability of the Laramie group with the coryphodon beds, the recognized base of the Eocene.

Dr. Newberry also claims while the term Hudson River group was, as stated by Professor Hall, just and convenient as applied to New York rocks, the Cincinnati series was not its equivalent, for it represented the whole maps of the Trenton group as well as the Hudson River and that the fossils of both formations were confusedly mingled at Cincinnati; that there were no lithological divisions of the series and that necessarily we must retain the term Cincinnati group as a local designation of a great series of lower Silurian rocks.

Prof. W. B. Rogers, in his section of Virginia rocks revised for MacFarlane's Directory, uses the terms Archæan, Middle and Lower Cambrian. Situn Cambrian or Upper Cambrian, Silurian, Devonian, Carboniferous, etc. He also puts the Oriskany at the top of the Silurian.

The exact relations of the beds on the Hudson River, New York, known as the Hudson River group, have been by some geologists misinterpreted, and the group as there exposed has been placed with some beds much older. But Prof. Hall recognized the importance of the distinct group, as Hudson River, in 1841, 1843, 1850 and 1858. The Canadian geologists at one time regarded these rocks as of the age of the Levis, and Prof. Hall in 1861 provisionally dropped the

term Hudson River, but his later observations have convinced him of the propriety of restoring it. In a paper read before the Nashville meeting of the American Association, August, 1877, he says: "Limited on the east by older rocks, the formation extends in unbroken continuity from the Hudson through the Mohawk valley, out-cropping on one or both sides of the river, expanding over a wide area in Oneida, Lewis, Oswego and Jefferson counties. Here interrupted by Lake Ontario, its extension may be taken up on the north shore of the lake and traced throughout the upper Peninsula. Thence upon the islands of Lake Huron, becoming more agillaceous and calcareous in its western extension, everywhere resting on the Trenton limestone and surmounted by the Medina, Clinton and Niagara groups. The formation everywhere contains the same species of fossils, with a largely increasing number of individuals and of species as we go westward. The forms known in the Hudson and Mohawk valleys are found at Toronto, in the islands of Lake Huron, Green Bay and elsewhere."

Prof. Mather, in his early geological reports of New York, traced the formation of the Hudson valley along the Mohawk. His arguments in favor of the term Hudson River group were accepted, and the name adopted.

Prof. Hall also considers the Cincinnati rocks as of the same age as the rocks between the Trenton below and Clinton or Niagara above. Certain older rocks near the Hudson River in their altered conditions were not readily assigned to their proper position by some geologists, and the true Hudson River group was placed with them, hence the confusion. In the *American Journal of Science* for January, 1879, Mr. T. Nelson Dale, Jr., mentions the finding of well-known Hudson River group fossils at Poughkeepsie, thus identifying the formation.

At a meeting of the Cincinnati Society of Natural History, held on the 23d day of January, 1879, a committee was appointed to consider the proper nomenclature of the Cincinnati rocks. Their report asserts that the lowest rocks at Cincinnati contain a fauna typical of the Utica slate for fifty feet from low water mark in the river. A little higher, the fossils as well as the position of the rocks indicate the age of the Hudson River group. Also that the fossils from Paris, L-xington and Highbridge, over the Kentucky River, as well as the lithological character of the strata, furnish abundant evidence of the existence of the Trenton group over an extensive tract of country in Kentucky. In the State of Kentucky we have the Trenton, Utica and Hudson River groups well represented, and the rocks have a northerly dip from Paris and Lexington toward the Ohio River. In Southeast Indiana the Lower Silurian rocks are referred to the Hudson River group. The Trenton is not represented in Ohio on the Ohio River as far as known, and the Utica is only represented in the banks of the river at Cincinnati; and all the other Lower Silurian rocks in Southwestern Ohio may be referred to the age of the Hudson River group.

The committee further recommend to drop the name of the Cincinnati group because it is a synonym, and its retention can subserve no useful purpose, and to retain the well-known names adopted by the New York geologists.

The report is signed by S. A. Miller, A. G. Weatherby, Paul Mohr, C. B. Dyer, R. M. Byrnes, and othe s.

MOUNTAIN MAKING—HOW THE ALPS WERE FORMED—A GEOLOGICAL THEORY.

Professor Judd, of the Royal School of Mines, London, gave recently an interesting explanation of the formation of the Swiss Alps. The results of geological observations, he said, show that four stages can be recognized in the history of these Alps. First, the existence of a line of weakness in the earth's crust nearly coincident with the line of the present mountains. This is evidenced by the fact that along this line of weakness there were volcanic outbursts, the result of which can still be traced. Secondly, there followed along this line of weakness a depression, and in this huge "trough," of miles in extent, there accumulated sands, lime-stones, and clays by various forms of water agencies, and by animals living in the waters. Thirdly, there followed the consolidation of these soft and loose materials. There is evidence that the accumulation was of from six to seven miles in thickness, and the mere weight of the superincumbent material on the lower strata would have a share in effecting consolidation. But this was not all. Under this vast covering heat had led to crystallization from fusion. There was, too, the crushing in from the sides of the trough. This was illustrated by a model of the late Sir H. de la Beche, where lateral pressure was employed on layers of different-colored cloth, showing how crumpling resulted, with uplifting of parts of the accumulated mass. Fourthly, there had been the sculpturing of all this into its present form, which was the work of rains and frosts. Some of the existing peaks, even 3000 feet high, were composed entirely of the disintegrated material resulting from the action of the water, either as ice in glaciers or as rain and streams. The amount of material removed in this way was so stupendous that it was almost staggering to try to grasp the facts. The sculpturing of the contours is still going on. This fourth stage was of quite recent date, speaking geologically; but the whole history involved a lapse of time which at the beginning of this century philosophers would not have been prepared to grant, even if the since-acquired knowledge of facts had been presented to them.

—*Engineering and Mining Journal.*

PHYSICS AND METEOROLOGY.

ON SOME PHYSICAL PROPERTIES OF ICE; ON THE TRANSPOSITION OF BOULDERS FROM BELOW TO ABOVE THE ICE; AND ON MAMMOTH-REMAINS.

BY JOHN RAE, M.D., LL. D., F. R. G. S., ETC. GOLD MEDALIST OF GEOGRAPHICAL SOCIETY.*

Is the ice formed on salt water fresh? or, in other words, if ice formed on the sea is thawed, will the water obtained thereby be fresh?

For a number of years past I have spoken with many persons on the subject;

* Read before the Physical Society, May 9, 1874.

and seldom, if ever, have I found a single individual who did not say that the ice of the sea was fresh.

Some of these gentlemen are known in the scientific world; and many of them supported their opinions by quoting the highest written authorities on the subject, chiefly Tyndall's "Forms of Water," p. 132, par. 339, which tells us that "even when water is saturated with salt, the crystallizing force studiously rejects the salt, and devotes itself to the congelation of the water alone. *Hence the ice of sea-water, when melted, produces fresh water.*"

It is the sentence in italics to which I wish to draw particular attention.

It would be the extreme of folly and presumption on my part to question the correctness of results obtained by scientific men in their experiments in freezing small quantities of sea-water by artificial means, more especially those of the disguished gentleman whose name I have mentioned, who, in addition to holding the high position of being one of our greatest authorities in all that relates to physical science, possesses the rare g ft of being able to communicate his knowledge in such plain, clear, and forcible language, illustrated by admirable experiments, as to make his meaning fully understood, even by those who had previously been perfectly ignorant of the subject.

It is only where I have had opportunities of witnessing the action of cold carried on in a manner which may have been denied to the scientific man, that I venture to differ from him; and it is in this way that the conviction has been forced upon me, that the ice of sea-water if melted *does not* produce fresh water.

Before entering upon this subject, however, let me say a word or two on the first part of the quotation I have given.

If a saturated solution of salt is frozen, and the ice so formed is fresh, it is evident that the salt that has been "rejected" must be deposited or precipitated in a crystalline or some other solid form, because the water, if any, that remains unfrozen, being already saturated, can hold in solution no more salt than it already contains.

Could not salt be obtained readily and cheaply by this means from sea-water in cold climates?

During several long journeys on the Arctic coast, in the early spring before any thaw had taken place, the only water to be obtained was by melting snow or ice. By experience I found that a kettleful of water could be obtained by thawing ice with a much less expenditure of fuel, and in a shorter time, than was required to obtain a similar quantity of water by thawing snow, Now, as we had to carry our fuel with us, this saving of fuel and of time was an important consideration, and we always endeavored to get the ice for this purpose. We had another inducement to test the sea-ice frequently as to its freshness or the reverse.

I presume that almost every one knows that to eat snow when it is very cold, tends to increase thirst, whereas a piece of ice in the mouth is refreshing and beneficial, however cold it may be; we were consequently always glad to get a bit of fresh ice whilst at the laborious work of hauling our heavy sledges; yet

with these strong inducements we were never able to find sea-ice, *in situ**, either eatable when solid or drinkable when thawed; it being invariably much too salt. The only exception (if it may be called one) to this rule, was when we found rough ice, which, from its wasted appearance and irregular form, had evidently been the formation of a previous winter. This old ice, if projecting a foot or two above the water-level, was almost invariably fresh, and, when thawed, gave excellent drinking-water. It may be said that these pieces of fresh ice were fragments of glaciers or icebergs; but this could not be so, as they were found where neither glaciers nor icebergs are ever seen.

How is this to be accounted for? Unfortunately I have only a theory to offer in explanation.

When the sea freezes by the abstraction of heat from its surface, I do not think that the saline matter, although retained in and incorporated with the ice, assumes the solid state, unless the cold is very intense, but that it remains fluid in the form of a very strong brine inclosed in very minute cells. So long as the ice continues to float at the same level, or nearly the same level, as the sea, this brine remains; but when the ice is raised a little above the water-level, the brine, by its greater specific gravity, and probably by some solvent quality acting on the ice, gradually drains off from the ice so raised; and the small cells, by connecting one with another downward, become channels of drainage.

There may be several other requisites for this change of salt ice into fresh, such as temperature raised to the freezing-point, so as to enable the brine to *work out* the cell-walls into channels or tubes—that is, if my theory has any foundation in fact, which may be easily tested by any expedition passing one or more winters on the Arctic, or by any one living where ice of considerable thickness is formed on the sea, such as some parts of Norway.

All that is required, as soon as the winter has advanced far enough for the purpose, is to cut out a block of sea-ice (taking care not to be near the outflow of any fresh-water stream) about 3 feet square, remove it from the sea to some convenient position, test its saltness at the time, and at intervals repeat the testing both on its upper and lower surfaces, and observe the drainage if any.

The result of the above experiment, even if continued for a long while, *may* not be satisfactory, because the fresh ice that I have described must have been formed at least twelve months, perhaps eighteen months, before.

THE TRANSPOSITION OF BOULDERS FROM BELOW TO ABOVE THE ICE.

When boulders, small stones, sand gravel, etc. are found lying on sea-ice, it is very generally supposed that they must have rolled down a steep place or fallen from a cliff, or been deposited by a flow of water from a river or other source. There is, however, another way in which boulders etc. get upon floe-ice, which I have not seen mentioned in any book on the subject.

During the spring of 1847, at Repulse Bay on the Arctic shores of America,

* What I mean by ice *in situ* is ice lying flat and unbroken on the sea, as found during the winter it is formed in.

I was surprised to observe, after the thaw commenced, that large boulders (some of them 3 or 4 feet in diameter) began to appear on the surface of the ice; and after a while, about the month of July, they were wholly exposed, whilst the ice below them was strong, firm, and something like 4 feet thick.*

On the shores of Repulse Bay the rise and fall of the tide is 6 or 8 feet, sometimes more. When the ice is forming in early winter, it rests, when the tide is out, on any boulders etc. that may be at or near low water mark. At first, whilst the ice is weak, the boulders break through it; but when the ice becomes (say 2 or 3 feet) thick, it freezes firmly to the boulder, and when the tide rises, is strong enough to lift the boulder with it. Thus, once fastened to the ice, the stone continues to rise and fall with the rise and fall of each tide, until, as the winter advances, it becomes completely inclosed in the ice, which by measurement I found to attain a thickness of more than 8 feet.

Small stones, gravel, sand, and shells may be fixed in the ice in the same way.

In the spring, by the double effect of thaw and evaporation, the upper surface of the ice, to the extent of 3 feet or more, is removed, and thus the boulders, which in autumn were lying at the bottom of the sea, are now on the ice, while it is still strong and thick enough to travel with its load, before favorable winds and currents, to a great distance.

The finding small stones and gravel on ice out at sea does not always prove that such ice has been near the shore at some time or other.

I have noticed that wherever the Walrus in any numbers have been for some time lying either on ice or rocks, a not inconsiderable quantity of gravel has been deposited, apparently a portion of the excreta of that animal, having probably been taken up from the bottom of the sea and swallowed along with their food.

MAMMOTH REMAINS—THE POSITION IN WHICH THEIR SKELETONS ARE FOUND, ETC.

In Lyell's "Principles of Geology," vol. i., p. 185, we read: "In the flat country near the mouth of the Yenesei River, Siberia, between latitudes 70° and 75° north, many skeletons of mammoths, retaining the hair and skin, have been found. The heads of most of these are said to have been turned to the south."

As far as I can find, the distinguished geologist gives no reason why the heads of the mammoths were turned to the south; nor does he say all that I think might be said of the reasons why, and the means by which the skins have been preserved for such a long period of time.

Having lived some years on the banks of two of the great rivers of America, near to where they enter Hudson's Bay, and also on the M'Kenzie, which flows into the Arctic Sea, I have had opportunities of observing what takes place on these streams, all of which have large alluvial deposits, forming flats and shallows, at their mouths.

*There were no cliffs or steep banks near, from which these boulders could have come, and the only way in which I could account for their appearance, was that which by subsequent observation I found to be correct.

What I know to be of common occurrence in these rivers may, if we reason by analogy, have taken place in ancient times on the great rivers of Siberia, making due allowance for the much higher northern latitude to which these streams run before reaching the sea, and for the difference in size of the fauna that used to frequent their banks.

When animals, more especially those having horns, tusks, or otherwise heavily-weighted heads, are drifting down a river, the position of the bodies may lie in any direction as regards the course of the stream, as long as they are in water deep enough to float them; but the moment they get into a shallow place, the head, which sinks deepest (or, as sailors say, "draws most water"), takes the ground, whilst the body, still remaining afloat, swings to the current, just as a boat or ship does when brought to anchor in a tideway.

It is probable that the mammoths, having been drowned by breaking through the ice or in swimming across the river in spring when the banks were lined with high, precipitous drifts of snow, which prevented them from getting out of the water, or killed in some other way, floated down stream, perhaps for hundreds of miles, until they reached the shallows at the mouth, where the heads, loaded with a great weight of bone and tusks would get aground in three or four feet of water, whilst the bodies still afloat would swing round with the current as already described.

The Yenesei flows from south to north, so the heads, being pointed up stream, would be to the south.*

Supposing, then, these bodies anchored as above in three or four feet of water; as soon as the winter set in, they would be frozen up in this position. The ice in so high a latitude as 70° or 75° north would acquire a thickness of five or six feet at least, so that it would freeze to the bottom on the shallows where the mammoths were anchored. In the spring, on the breaking up of the ice, this ice being solidly frozen to the muddy bottom, would not rise to the surface, but remain fixed, with its contained animal remains, and the flooded stream would rush over both, leaving a covering of mud as the water subsided.

Part of this fixed ice, but not the whole, might be thawed away during summer; and (possibly, but not necessarily) next winter a fresh layer of ice with a fresh supply of animal remains might be formed over the former stratum; and so the peculiar position and perfect state of preservation of this immense collection of extinct animals may be accounted for without having recourse to the somewhat improbable theory that a very great and sudden change had taken place in the climate of that region.

I have seen at the mouth of Hayes River in America animals frozen up as above described; but as the latitude of this place is only 57° north, the fixed ice

*Not many years ago, when buffalo were very abundant on the Saskatchewan, hundreds of them were sometimes drowned in one season whilst swimming across the river; and many reindeer, moose, and other animals are annually destroyed in this way in other large American rivers.

Sir Charles Lyell mentions a number of yaks being seen frozen up in one of the Siberian rivers, which, on the breaking up of the ice in spring, would be liberated and float down the stream.

usually wholly disappears before the next winter sets in, and liberates the animals shut up in it; but when the rivers reach the sea, as some of those of Siberia do, 1,000 or 1,200 miles further to the north, it may be fairly assumed that a large part of this fixed ice, protected as it would be by a layer of mud, might continue unthawed.

Addenda.—It is not difficult to account for the remains of mammoths being found in a fresh state in the ice-cliffs on the banks of the great Siberian Rivers. On these rivers (especially far north) the immense pressure of the water in shoving, forces the ice in great heaps on to the shore, and with the ice any dead animal, which would be preserved for any length of time whilst the ice-cliff remained entire.

A PLAN FOR ESTABLISHING LIFE-SAVING AND SIGNAL STATIONS IN MID-OCEAN.

ISAAC P. NOYES, WASHINGTON, D. C.

As navigation increases between the old and new world, the necessity for life-saving stations in mid-ocean is more and more felt every year.

This has undoubtedly been a subject that in some way or other has presented itself to many minds—to some as only a passing thought, as quickly away as it came; to others a thought chiefly in connection with its seeming impracticability, while to a few it has been much dwelt upon, in hopes of solving it in some way or other that would be of practical value to mankind—either for the saving of life or for the interest of science. Had this problem, in all its various details, been easy to solve, so as to have become a practical reality, something ere this would have been done toward accomplishing it.

Of course the great impediment in the way is the enormous depth of water, making it, under any present known system, simply absurd to entertain thoughts of locating anything in the shape of a vessel or buoy that must necessarily require such an extensive cable in order to secure it in its place. There would be no trouble about the anchorage, or the vessel or buoy, in what was at the bottom or at the top, but simply in the connecting link between the two. "Simply" in this case though, like in many others, is the chief and almost impossible thing—that is seemingly impossible up to this date. As we read the history of the world we see that safety guards and institutions for the interest of science are more and more established as the world progresses, and what at one age would not have been demanded or even hardly thought of, in another is looked upon as an indispensable necessity. What is considered as impracticable in one age, in another or future age is smiled at and done apparently without the least possible effort, as though it was the most easy and natural thing imaginable.

Such a subject may prompt the question, Is it desirable even if practical? and perhaps many may scout the practicability of such an idea. When we read

of some fearful accident or wreck at sea, where some noble ship containing hundreds of precious lives has gone down with all on board, or only a few left to tell the mournful tale, this question of life-saving stations far out away from land has presented itself in a very forcible manner, and the mind seems impatient and would leap at once to the rescue to prevent or lessen the fearfulness of such catastrophes. But no sooner is this thought through the brain than "How?" presents itself. How overcome this huge difficulty in the way? how make this *connecting link*, the cable, that shall secure the vessel or buoy to the anchorage at the bottom? After a number of years' thought on this subject a suggestion finally occurred to me whereby, I think, this connecting link may be made a practical thing, and no longer be in the way of the consummation of this auxiliary to the safety of ocean travel, and the means of taking regular mid-ocean observations the same as on land. For the cable proper I would not have anything unlike cables in general, yet would suggest a galvanized iron wire cable similar to those used on large derricks, in place of the regular chain as employed by vessels for anchoring; as on the whole I think it would be stronger. But then the matter of the kind of cable in this connection just now is not of much importance, the principal point being now how to construct and lay it so that it will be a practical thing.

Some parties who have thought on this question have sugges ed the anchoring of an immense buoy, and making of this a huge store-ship, &c. In this place I would remark that I think that a buoy properly shaped and constructed would be better than a vessel, for the reason that the upper portion of the cable could be so arranged as not to interfere with passing vessels. Experts say that the trouble with the buoy and cable would be two-fold: First, the great length of chain would require it to increase very fast in size as its distance increased from the bottom in order simply to have sufficient strength to hold itself up. Second, this great weight would necessitate a buoy or vessel of such huge proportions as to make the thing as a whole simply impracticable in the way of cost, etc.

Sometimes it may be best to have the strength of a thing concentrated in one support or bearing, but in general the more we divide it up the better, and this would seem to be the idea to follow out in this cable or connecting link.

There would be no trouble in constructing a number of small buoys. So in the place of one huge buoy, which experts say would have be so large, I would have a number of smaller ones, and these I would have at intervals of about two hundred and fifty feet, or thereabout. But the exact measurement of these intervals is of very little consequence at present; they may be more or less, and could easily be determined upon whenever it was proposed to carry the idea into effect, and would depend upon the size of the buoy, weight of cable adopted, etc.

This length, two hundred and fifty feet, is simply taken in order to illustrate the plan with a little more facility, as most people can understand such things by illustration better than by abstract or technical terms. The depth of the Atlantic Ocean where such anchorages would be required is from 10,000 to 15,000 feet. At 250 feet for a section, this would make from twenty to thirty sections, requiring twenty to thirty buoys. If each buoy had sufficient bearing capacity to support

its section of cable, it will readily be seen that the cable will stand as to strength on the same relative proportion and basis as any ordinary cable of 250 feet; so that if the anchor was in water three miles deep, the strength of chain or cable would be intact for the purpose of holding the vessel or buoy at the surface, as though at any ordinary anchorage.

Many may ask how are we to get these buoys all strung, as it were, on this cable, into position. This, at first, seemed as unsurmountable as the cable itself, but now it seems the easiest thing imaginable; and, in fact, not more difficult than it would be to effect any deep anchorage. Let the cable be constructed with the buoys all attached at their regular intervals, and in this manner towed to their respective grounds; soundings of which should be taken in advance, in order to determine the necessary length of cable, allowance to be made for the angle at which the cable would lie in the water. When this has been accomplished, secure the anchor and let-go, and like any other anchor there would be no trouble in its finding its way to the bottom and taking hold.

When located, these buoys or stations should be manned much after the manner of light-ships and life-saving stations, combined with lights, signals, stores and life-saving implements; and in addition to this have regular signal officers stationed upon them, with established communications with the head-quarters on shore via the ocean telegraph. Then we could begin to trace storms upon the ocean as well as upon the land, and if for no other purpose it would seem that these stations would pay for themselves.

After having constructed the stations and suggested what could be accomplished by them, the practical mind will certainly ask how will we pay for them. Even if good, there must be a great many of them in order to have them of any practical value. I propose to follow up the same idea as in regard to the construction—divide up the cost between the nations. All the civilized people of the world are interested in the safety of the travel between the old world and the new, and it would seem should likewise be interested in the attempt to trace the line of a storm on the ocean as well as on the land, for only thereby can we become as familiar as we should be with the weather of the whole globe.

The great powers, like the United States, England, France, Germany, Russia, etc., should each construct and maintain a certain proportion, and the smaller and more distant powers like Holland, Italy, Turkey, etc., a smaller proportion each. In order to stretch across the ocean between America and Europe, a contribution of two from each of the larger powers and one from each of the smaller powers would locate them within the comparatively short distance of 150 to 200 miles of each other. We cannot locate ocean accidents or tell just where storms may happen, and then place our buoys or vessels, neither is there an attempt to do this in our life-saving and weather stations on land. That would be simply impossible. It is not proposed either at present to be able to get them close enough to be in the neighborhood of every accident or on the line of every storm, yet if placed at these intervals I think that they would pay for themselves in the good they would secure to humanity. We read of mighty works done in

the past, but when we come to look at them carefully we find them executed by unwilling hands—a serf class—all for the mere vanity of those in power, and not for any real good to mankind. Somehow or other the world has always spoken of the present age in a mere hard mechanical way. We have the Stone, Brass, Iron Age, etc., though occasionally we have the more intellectual designation of "Age of Reason," yet I think there is another name by which this age should be known, "Age of Humanity." No age of the world has done so much for humanity at large; sure, there are some minor exceptions, but then all ages have had these more or less. I think that we have the least bad and the most good; so in respect to the numerous things that are done purely out of brotherly love, I think it full time that we call this the "Age of Humanity," and I hope that the benefactors of mankind may go on and never stop, but continue to extend their genial influence from age to age. Here in this ocean life-saving and signal service I think that there is an opportunity for some of our well-disposed millionaires like Peabody, Lick, Cornell, and others of their kind, to establish one of these stations in the ocean. I doubt if their money could be put to any better purpose than in helping carry out some such plan for the benefit of science, and for the additional safety of those who "go down to the sea in ships."

KANSAS METEOROLOGICAL SUMMARY FOR 1878.

BY PROFESSOR F. H. SNOW, METEOROLOGIST TO THE KANSAS STATE BOARD OF AGRICULTURE.

STATION: Lawrence, Kansas. Latitude 38 degrees, 57 minutes, 25 seconds; longitude, 95 degrees, 15 minutes, elevation of barometer and thermometers, 875 ft. above the sea level, and five feet above the ground; rain gauge on the ground; anemometer, 105 above the ground, on the dome of the University building, 1,200 feet above the sea level.

The chief characteristics of the weather of 1878 were the large and well distributed rain-fall, the high average temperature, the absence of great extremes of temperature, the long period of immunity from severe frosts, the comparative lightness of the winds and the low temperature and great snow-fall of the month of December.

TEMPERATURE.

Mean temperature of the year, 55°.33, which is 2°.37 above the mean of the ten preceding years. The highest temperature was 98° on the 15th of July and 24th of August; the lowest was 6° below zero, on the 18th and 25th of December, giving a yearly range of 104°. Mean temperature at 7 A. M., 49°.46; at 2 P. M., 64°.32; at 9 P. M., 55°.31.

Mean temperature of the winter months, 32°.41, which is 2°.79 above the average winter temperature; of the spring, 57°.37, which is 4°.58 above the average; of the summer, 75°.13, which is 1°.20 below the average; of the autumn, 56°.33, which is 3°.87 above the average.

The coldest month of the year was December, with a mean temperature of

23°.05; the coldest week was December 21st to 27th, with mean temperature, 11°.18; the coldest day was December 24th, with mean temperature, 4°.2. The mercury fell below zero seven times, all of which were in December.

The warmest month of the year was July, with a mean temperature of 78°.45; the warmest week was July 10th to 16th, with mean temperature, 83°.90; the warmest day was July 14th, with mean temperature, 85°.6. The mercury reached or exceeded 90° on 35 days, viz: 15 in July, 14 in August, and 6 in September.

The last light frost of spring was on May 14th; the first frost of autumn was on October 18th, giving an interval of 157 days entirely without frost. The last severe frost of spring was on March 4th; the first severe frost of autumn was on October 18th, giving an interval of fully seven months, or 228 days, without severe frost. No frost or cold weather during the year caused any damage to fruit or fruit buds.

RAIN.

The entire amount of rain, including melted snow, was 38.39 inches, which is 3.48 inches above the average annual amount for the ten preceding years. Either rain or snow fell on 107 days. The longest interval without rain during the growing season (March 1st to October 1st), was 12 days, July 8th to July 20th. The number of thunder showers was 38. These occured in all months of the year except November and December. There were three light hail-storms.

SNOW.

The entire depth of snow was 25½ inches, of which 2½ inches fell in February, 1 inch in October, 2 inches in November, and 20 inches in December. The last snow of spring was on March 29th; the first snow of autumn was on October 26th. The single storm of December 12th and 13th brought 14 inches of snow,—this being the greatest snow-fall on our 11 years record.

FACE OF THE SKY.

The average cloudiness of the year was 40.65 per cent, which is 4 55 per cent. below the average. The number of clear days (less than one-third cloudy) 190 half clear, 93; cloudy (more than two-thirds), 82. There were 59 entirely clear, and 37 entirely cloudy days. The clearest month was August, with an average cloudiness of 19.19 per cent.; the cloudiest month was February, with an average of 54.63 per cent. The mean cloudiness at 7 A. M. was 47.32 per cent; at 2 P. M., 44.99 per cent.; at 9 P. M., 29.66 per cent.

DIRECTION OF WIND.

During the year, three observations daily, the wind was from the N. W. 327 times; S. W., 281 times; S. E., 134 times; N. E., 136 times; E., 60 times; S.. 55 times; W., 28 times; calm, 21 times. The north winds (including north-west, north and north-east), outnumbered the south winds (including south-west, south and southeast), in the ratio of 516 to 470.

VELOCITY OF THE WIND.

The number of miles traveled by the wind during the year was 125,793,

which is 16,078 miles less than the average annual distance for the past six years. This gives a mean daily velocity of 344.47 miles, and an average hourly velocity of 14.34 miles. The highest hourly velocity was 60 miles, on April 9th; the highest daily velocity was 919 miles on March 8th; the highest monthly velocity was 15,106 miles, in October. The three windiest months were March, May and October; the three calmest months were February, July and August. The average hourly velocity of the wind at 7. A. M. was 13 44 miles; at 2 P. M.. 16·39 miles; at 9 P M., 14.07 miles.

BAROMETER.

Mean height of the barometer, 29 067 inches; mean at 7 A. M., 29,090 in.; at 2 P. M., 29.047 in.; 9 P. M., 29,063 in. Maximum, 29.735 inches, on December 24th; minimum, 28.335, on April 9th; yearly range, 1,400 inches. The highest monthly mean was 29.268 inches, in December; the lowest was 28.851 inches, in April, The barometer observations are corrected for temperature and instrumental error.

RELATIVE HUMIDITY.

The average atmospheric humidity for the year was 70.4; at 7 A. M., 81.26; at 2 P. M., 50.82; at 9 P. M., 77.22. The dampest month was July, with mean humidity, 78.27; the driest month was November, with mean humidity, 62.60. There were only five fogs during the year. The lowest humidity for any single observation was 18.2, on November 23d.

The following tables give the mean temperature, the extremes of temperature, the velocity of the wind, the percentage of cloudiness, the relative humidity, and the rain-fall, for each month of the year 1878, and a comparison with preceding years:

Months.	Mean temperature.	Maximum temperature.	Minimum temperature.	Miles of Wind.	Mean Cloudiness.	Relative Humidity.	Rain-fall in inches.
January	33 97	55.0	7.5	9.996	47.42	73.40	3.05
February	40.22	66.0	15.5	7.393	54.63	76.50	2.86
March	50.90	81.0	27.0	11.994	40.86	67.64	2.67
April	58.60	82.0	36.0	11.482	38.22	66.03	5.48
May	62.60	85.0	38.5	12.207	52.90	70.90	5 66
June	69.79	89.0	50.0	9.187	48.66	74.80	5.67
July	78.48	98.0	58.0	7.974	31.29	78.27	4.30
August	77.14	98.0	56.0	8.188	19.19	74.60	2.22
September	67.58	94.5	41.0	11.972	30.66	66.40	2.51
October	55.55	87.0	20.0	15.106	28.92	63.70	0.44
November	45.87	72.0	22.0	.11.198	42.00	62.60	1.55
December	23.05	53.0	6.0	9.096	55.75	65.70	1.98

COMPARISON WITH PREVIOUS YEARS.

Years.	Mean temperature.	Maximum temperature.	Minimum temperature.	Miles of Wind.	Mean Cloudiness.	Relative Humidity.	Rain-fall in inches.
1878	55.33	98.0	−6.0	125.793	40.65	70.4	38.39
1877	54.16	99.0	−9.0	113.967	47.12	72.6	41.09
1876	52.76	98.0	−5.0	148.120	41.27	66.8	44.18
1875	50.60	99.0	−16.5	145.316	44.81	65.5	28.87
1874	54.20	108.0	−3.0	145.865	45.54	65.5	28.87
1873	52.71	104.0	−26.0	154.508	42.46	64.0	32.94
1872	51.90	97.0	−18.0	....	44.33	64.4	32.63
1871	54.30	103.0	−6.0	....	47.37	....	33.23
1870	54.50	102.0	−10.0	....	47.88	68.4	31.38
1869	50.90	96 0	−5.0	....	49.23	....	38.51
1868	53.36	101.0	−16.5	....	42.35	....	37.42

—*Kansas Collegiate.*

KANSAS METEOROLOGICAL SUMMARY FOR JANUARY, 1879.

BY SAML. W. RHODE, SERGEANT SIGNAL CORPS, U. S. A.

The most notable features of the weather during January, 1879, were the high pressure and remarkable low temperature of the first half of the month; the high percentage of humidity and the light precipitation.

The mean pressure of the month was 30.189, which was .04 above the average. The highest barometer was 30.781, on the 3rd, and the lowest 29.596, on the 22d.

The mean temperature of the month was 23.63°, being about 3° below the January average. The highest temperature recorded during the month was 56°, on the 27th; the lowest −14.5°, on the 3d. Lower temperature than this has been recorded at this station in January of previous years as follows: In 1873, −26°, and in 1875, −20°. The greatest daily range of temperature was 35.5°, on the 20th, and the least 5°, on the 28th.

The mean percentage of humidity during the month was 75.79, about 5 per cent above the average for January.

The total rain-fall during the month was 1.16 inches, being slightly less than the January average. The largest rain-fall in January observed at this station, was 3.14 inches, in 1874, and the least 0.13 inches, in 1872. The heavy snow which fell on Dec. 13th, 1878, remained on the ground during the greater portion of January, and is said to be the longest period snow has remained on the ground in this portion of the State since 1856.

The prevailing wind of the month was south. Total number of miles traveled, 4,228; highest velocity, 21 miles, from the north, at 12:30 p. m., 1st.

Two hundred and seventeen observations of the wind's direction were made, as follows: North, 44 times; northwest, 57 times; west, 1 time; southwest, 6 times; south, 66 times; southeast, 12 times; east, 6 times; northeast, 12 times, and calm 13 times.

Number of clear days 10; fair days 9; cloudy days 12 and days rain fell on 7.

The following tabular statement of January mean temperatures and total rainfall will give a comparison of the past month with previous years:

COMPARATIVE TEMPERATURES.	Degrees.	COMPARATIVE PRECIPITATION.	Inches.
1872	25.03	1872	0.13
1873	19.15	1873	3.02
1874	28.40	1874	3.14
1875	16.70	1875	0.23
1876	35.40	1876	1.42
1877	24.60	1877	0.73
1878	33.80	1878	2.34
1879	23.63	1879	1.16

LEAVENWORTH, KANSAS, Feb. 1, 1879.

MISSOURI WEATHER SERVICE, JANUARY, 1879.

BY PROFESSOR F. E. NIPHER, DIRECTOR.

January, 1879 has been unusually cold. From December 11th to January 15th, the daily mean was constantly below 32° F. During the first decade (10 days) of January, the temperature did not rise above 32° F., the mean temperature of this decade being 9.

The mean of the month was 26°·95 (normal 31.6). Since 1836, the January temperature has been lower than this seven times, the lowest being 19°.3 in 1857. The extreme temperatures of January 1879 were, –14° and 59°, a range of 73°.

The snow-fall of the month was 7.6 inches, the rain (and melted snow) amounting to 1.86 inches (normal 2.17). The ground was covered with snow until January 20th, the snow having been on since December 15th (37 days).

In the State the northern and western parts have received less than one inch of rain. The lower Missouri valley and the extreme southern part having received over two inches. On the 28th (P. M.) a light shower, accompanied with heavy peals of thunder, covered the poorly represented region to the south of the lower Missouri.

At Centreville, 19th at 9 P. M., temperature being 10°, bright starlight, a sound resembling a long peal of thunder, was heard over a region of at least 5 by 10 miles. Possibly subterranean.

The snow-cover disappeared at Neosho 16th, E. Prairie 17th, Lebanon and

St. Louis 20th, Cuba 22d, Pleasant Hill and Harrisonville 25th, Glasgow 26th, Lexington, Booneville and Hamilton 27th, Columbia 28th. The snow-line probably reached the northern limit of the State by the 31st, but the scarcity of stations there makes precise statement impossible. The river opened at Booneville, 29th.

The following low temperatures were observed, all *minus*:

On the 4th, Macon 22, Hamilton 23, Booneville 22, Lexington 17, Harlem 16, Kansas City 20, Harrisonville 20, Columbia 24, Mexico 20, Cuba 19, Lebanon 14.2, Sikeston 4, Jackson 12, Ironton 10. On the 3d, St. Louis 14, Oregon 22, Corning 23, Macon 22, Phelps City 24, Sedalia 20. At Neosho 9 on the 6th.

Buds of peach and raspberry are reported killed at Springfield, and of peach and apricot at Louisiana. At Lexington, along the river, the peach bud is safe, but reported killed six miles from the river.

At Glasgow robins were seen 25th, and blue-birds 28th. The sleighing season ended at Oregon 25th, after a continuance of 50 days.

WASHINGTON UNIVERSITY,
St. Louis, Feb. 5th, 1879.

COLORADO WEATHER REPORT.

SUMMIT, COLORADO,
December, 1878.

Highest temperature, 38°+.
Lowest temperature, 21°—.
Mean temperature, 7°.9+.
Mean of minimum temperatures, 3° 2+.
Mean of maximum temperatures, 20°.3+.
Total snow-fall, 25¾ inches. No rain.
Total melted snow, 2.58 inches.
Prevailing wind, West.
Maximum velocity of wind, 70 miles an hour.
Number of days on which snow fell, 12.
Number of cloudy days, 7.
Number of fair days, 3.
Number of clear days, 20.
Cloudless days, 1.
Depth of snow in inches at close of month, 30.

Two solar halos on 13th; morning and afternoon: latter accompanied by brilliant parhelia.

One of the severest snow storms on record at the Summit ended at 8 o'clock p. m., January 1, 1879, after a continuous duration of 115 hours; during which time the wind velocity averaged 48 miles per hour, and the temperature 7°.2+ Fahr. Total snow-fall, 16 inches.

C. E. ROBINS, V. O.

BOTANY.

LEAVES AND THEIR FUNCTIONS.

BY REV. L. J. TEMPLIN, HUTCHINSON, KAS.

A leaf, whatever may be its configuration or color, is always an object of interest But how few people when they see a leaf as it waves and flutters in the breeze really know what they are looking at. Leaves appear in an endless variety of forms, sizes and colors. They are often so transformed that it is more by the place they occupy than by their forms that we know they are leaves. Underground stems or rhizomas have them at each point or node as little thin scales. Buds are enveloped in peculiar cerements, which generally fall away soon after the ordinary leaves have begun to expand ; those enveloping scales are only leaves in a modified form. They are quite prominent in the hickory and horse-chestnut. The scales of bulbs, as of the lily, are simply modified leaves. Flowers are only aggregations of metamorphosed leaves. But it is with leaves as foliage that we are more immediately concerned at present. A complete leaf consists of three parts ; the stalk or stem (petiole) on which it rises, the expanded blade or lamina, and two small leaf-like appendages at the base of the leaf-stalk called stipules. The only essential part is the blade, as this may be sessile on the stem without either petiole or stipules. The blade of a leaf consists of three portions ; the woody frame-work, ribs or veins, the green cellular portion, pulp, and the outside covering or epidermis. The epidermis, which is really an extension of the outer bark of the stem, is composed of closely-united, transparent cells, with frequent openings through it called stomata or breathing pores. These vary in number from 800 to 170,000 to the square inch of surface. It is through these that water is exhaled from the plant. They are more numerous in the leaves of plants growing in moist situations and surrounded by a damp atmosphere. The pores dilate with the increase of humidity and contract with the increase of aridity. Plants growing in arid climates have but few stomata, and these are very small. While the most of foliage appears to be made on the principle of exposing the greatest possible surface to the air; some forms of vegetation seem to be constructed for the accomplishment of the very reverse of this. Thus the various species of cactus, whose native habitat is the hot, arid plains of the Southwest, are constructed on the principle of presenting the least extent of surface to the air, and this surface is covered with an epidermis that is almost impervious to water. This is necessary to prevent excessive transpiration in that very dry climate. The pulp or parenchyma of the leaf is made up of several layers of cells. These cells are small globular sacks, varying from 1-1200 to 1-250 of an inch in diameter. A layer of these of a rather elongated form

is arranged immediately beneath the epidermis of the upper side of the leaf with the ends to the surface. These are crowded quite closely together. Another layer, not quite so much elongated and less compactly arranged, is found on the under side of the leaf. Between these two layers are numerous globular cells that seem thrown together without any great regularity or order. Among these are numerous irregular passages, intercellular spaces, through which water and air circulate. These reach the surface through the stomata of the epidermis. It is worthy of notice that by far the larger part of these breathing pores are on the under surface, and this surface always seems to avoid direct sunshine. If a leaf is inverted, turning the bottom side upward, it will, if possible, return to its natural position, and if prevented from so doing it will soon die. A few leaves have been known to grow in a vertical instead of a horizontal position. The framework of leaves consists of wood, and is intended to give firmness and support to the leaf. It is divided into numerous veins or nerves that ramify every part of the green parenchyma. There are two distinct systems of venation of leaves: the parallel veined and the net veined. In the former the fibers run nearly parallel from one extremity of the leaf to the other; such leaves are usually long and narrow, linear, as in the grasses, corn, &c. In the other the veins are netted, ramifying the leaf in all directions and dividing the parenchyma into numerous small squares and diamonds. This style of venation exists under two forms; in one a principal vein, midrib, extends from the base to the apex of the leaf, and from this numerous smaller veins branch off and run to the margin; in the other there are three or five nearly equal ribs running the length of the leaf. The first is feather veined from its resemblance to a feather, and the other is palmately veined, the main ribs branching out like the fingers of a hand. The shape of a leaf is generally determined by the manner of its venation. The two principal styles of venation belong to and denote two different classes of plants, the parallel-veined belonging to the monocotyledonous, and the net-veined to the dicotyledonous divisions of the vegetable kingdom. Thus the veining of a small portion of a leaf will indicate to which of these classes the plant upon which it grew belonged.

The green color of leaves comes from a granular substance, chlorophyl, found in the cells of the parenchyma. In its absence no true vegetable structure can be built up from the original elements, and it can operate only in the presence of sunlight. Low cryptogamic plants will grow in the dark, but they contain no proper chlorophyl. Chlorophyl has been found to be composed of two different substances, xanthophyl, a yellow substance, and cyanophyl, a blue material; their union forms chlorophyl, or leaf-green. It is thought that the yellow color of leaves at maturity is caused by the predominance of xanthophyl at that time. Besides chlorophyl the leaf cells contain the proximate principles of the plant, and here the real work of building plant structure is performed. But this brings us to the consideration of the second part of our subject, viz: the functions of leaves.

In treating this branch of the subject, it will be necessary to consider the leaf under several different characters. Leaves should be considered as real living

beings, capable of performing vital functions, as workers performing a large amount of important work. We may first consider *the leaf as a pump.* One of its most important offices is to pump up water from the soil through the roots and stems of plants. This it exhales through its stomata in the form of invisible vapor. By this means a large quantity of water is carried up from the soil to the atmosphere. Thus a large portion of water that would quickly settle down through the deeper soil and find its way into underground passages, is carried up and given off to the atmosphere, where it is condensed into clouds and descends in rain, thus watering and making fruitful the earth. Without this work many parts of the earth that now blossom as the rose would become arid wastes. The amount of moisture thus carried up and exhaled by the foliage of trees and plants is immense. A sunflower, with a leaf surface of 39 square feet, exhaled three pounds of water in twenty-four hours. A corn plant, in about three and a half months, gave off in vapor thirty-six times it own weight of water. A medium sized forest tree will pump up and exhale about five barrels of water in twenty-four hours. This will give about 800 barrels to the acre. An acre of grain or grass will do about the same. From this it may be seen why forests exert such a powerful influence on the rainfall of a country.

Again, we may consider *the leaf as a lightning conductor.* It is one of the most efficient conductors of electricity ever made. Most leaves have notched edges; each of these "points" is powerful to attract the electric fluid from the air and through the stem convey it silently to the ground. A single blade of grass is said to be three times as powerful to attract electricity as a fine cambric needle, and a twig covered with leaves is more efficient than the best constructed "patent point." A tree covered with leaves is the most efficient safeguard from lightning that can be found.

A green tree is constantly conveying electricity from the earth to the air and from the air to the earth. True, it sometimes tries to carry too large a load in response to the efficient collecting power of the leaves. They gather it in faster than the trunk can carry it away and it is bursted. We say the tree is struck with lightning. But it has often been struck before, but this time it was overloaded and crushed. Trees are natural lightning-rods, more efficient than all the artificial ones that have ever been invented.

In the next place we may contemplate *the leaf as an organizer* of organic matter. It is here that it has performed its most efficient and important service for man. Through its agency every particle of both vegetable and animal organism has been either directly or indirectly built up. Every plant, tree and shrub has been directly built up through the labor of the leaf, and every animal, whether fish, reptile, bird or mammal, whether domesticated or wild, useful or injurious, has found its support in the material organized through the labor of the leaf. And even long before the present order of things existed, the leaf was at work. Through its labors vast beds of vegetable matter were laid away far back in the carboniferous ages, which by heat and pressure have become coal, forming vast storehouses of excellent fuel. And still further back in times when silurian seas washed the

shores of limited bodies of land, the leaf was at earnest, ceaseless toil. Thus we owe to the leaf not only what makes life pleasant, but our food and raiment and fuel, without which life would be impossible. Without the leaf as an organizer the earth would sink back into a lifeless, pulseless waste.

Lastly, we may consider *the leaf as a chemical agent*, withdrawing and consolidating various poisonous gases, which if left in the air would render it unfit to sustain life, and thus convert the earth into one vast charnel-house of the dead. The air contains $\frac{1}{2500}$ of its own bulk of carbonic acid, consisting of two equivalents of oxygen and one of carbon. This gas is a deadly foe to animal life, and if permitted to accumulate in the air would soon render it unfit to sustain life. And yet there are certain processes constantly going on that tend to augment the proportion of this gas in the atmosphere. Every breath of every human being and every living animal, and every bit of fuel that is consumed, and every particle of vegetable matter that decays, and every volcano that sends forth its deadly fumes, are adding to the quantity of this gas in the atmosphere. By what agency, then, is the equilibrium maintained? It is through the agency of our little friend the leaf that the work so essential to life and health is performed. It is constantly employed as an analytic chemist imbibing this poisonous gas and analyzing it, using the carbon to build up the organic substance of its own structure, and giving up the healthful, life-giving oxygen to the atmosphere again. This process is so regulated as exactly to keep pace with the liberation of carbonic acid through the agencies mentioned above. Other deleterious gases are thus taken in and rendered innocuous. The blue gum (*Eucalyptus globulus*), of Australia, has become famous for absorbing the deadly gases in miasmatic districts and thus rendering them healthy. Thus the leaf labors preparing food for all living animals, and raiment and and fuel for the lords of creation, as well as all wood and bone and ivory used in the arts. It also purifies the air, making animal life possible, and clothing the earth with beauty that the life thus preserved may be replete with the highest enjoyment.

ON PLANT-DISTRIBUTION AS A FIELD FOR GEOGRAPHICAL RESEARCH.

BY W. T. THISTLETON-DYER, ASSISTANT DIRECTOR OF THE ROYAL GARDENS, KEW, LONDON.

This is a lecture, delivered (we believe) at the Royal Institution, and published originally in the Proceedings of the Royal Geographical Society, London. Its teaching is interesting and truly noteworthy. It tells how "Vegetation in any given spot maintains its own only by having solved the problem of existing in the best way under the given circumstnaces. Introduce a new competitor for a particular site that can solve the problem rather more closely, and the old occupant must needs give way." It intimates that this must

have been so all along geological time, and under all changes of climate, land and sea. It pictures the great hosts of plants oscillating between the poles and the equator, their ranks thinning by "the friction attendant on their movement," which has extinguished perhaps whole battalions. It takes a general survey of the prominent characteristics of the great floras, northern, southern and tropical, and of their principal divisions. It brings prominently forward "the opinion that the northern hemisphere has always played the most important part in the evolution and distribution of new vegetable types; in other words, that a greater number of plants have migrated from the north to the south (meaning across the tropics) than in a reverse direction." That proposition (based on the temperate floras) is well sustained by obvious facts, and follows almost of course from the greater amount and longitudinal contiguity of northern lands, as Mr. Darwin has "suspected" But this may probably be limited to the extant vegetation and its nearer predecessors. If the palæonotlogical botanists are at all correct in their ordinal determinations, the reverse might well have been the case at earlier periods, when Proteaceæ and Laurineæ abounded in northern temperate regions. It must needs have been so if there was for any long period a preponderance of southern land with northward extension.

A good part of the lecture—as rich in practical value as the remainder is in theoretical interest—recounts what geographical explorers have recently been doing for botany by collecting materials and information, indicates how very much is yet to be done in this way, how easy it is to collect and preserve botanical specimens, and what important services the "roving Englishman" and still more the disciplined explorer, may render to the botanical studies.

—*American Journal of Science.*

CORRESPONDENCE.

War Department, Office of the Chief Signal Officer,
Washington, D. C., January 26, 1879.

Editor Kansas City Review of Science and Industry:

My Dear Sir:—At request—or rather suggestion—of Dr. Rae, first discoverer of the fate of Sir John Franklin and his crew, I send you the inclosed paper of his for insertion in the Review. It will be an interesting addition to the next issue. You see the Review is read in England as well as in America.

I send you also an extract from his last letter to me, in which he corrects an error in connection with the finding of the Resolute, as published in the official records. Very truly yours, H. W. Howgate.

London, England, 2 Addison Gardens, 6 January, 1879.

Dear Captain Howgate:—I am this morning in receipt of the Kansas City Review, which you have so kindly sent me, and I have renewed my remembrance of the finding of the Resolute (after her disgraceful abandonment by Belcher's orders) by one of your whalers, and the graceful manner in which she was returned to this country by your government. In your narrative there is only one point to which I take exception, which is the mistake of the gentleman who brought the subject before your Senate, on June 10, 1856.

Mr. Foster states that the Resolute was "abandoned by her officers and crew in Wellington Inlet."

This is a mistake, for the ship was abandoned 120 miles to the west of Wellington Inlet, and had never been in the Inlet at all during the whole voyage.

Belcher, who himself did go up Wellington Inlet, did abandon his two ships there, whilst Kellett, the second in command, went westward. The abandonment of these four (4) perfectly sound and uninjured vessels was only *necessary* and *unavoidable* because Belcher—contrary to the opinion of Kellett and all the other officers—thought it was so. At the court-martial held on the subject, Belcher escaped a severe reprimand by, for him, one lucky clause in his orders. His sword was returned to him in silence.

A great part of the officers and crew were in perfect health, and a number of the former volunteered to remain by the ships with sufficient men to bring them home when the ice broke up, as there was every probability of its doing in a couple of months. Their indignation and chagrin at being refused was extreme.

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Faithfully yours, John Rae.

THE WALLED LAKES OF IOWA.

Pleasant Hill, Mo., January 26, 1879.

Editor Review of Science and Industry:

Dear Sir:—In the Review for January you quote an article on "Walled Lakes of Iowa," from a Dubuque paper. The editor of the *Herald* evidently is not conversant with the Geological Reports of his own State, or he would not have inserted such an article in his paper. For explanation, see Geology of Iowa, by C. A. White, vol. I, pp. 74 to 78 inclusive. Prof. White names two such lakes, one in Wright county and another in Sac. They are drift lakes, and similar features, he says, accompany all the drift lakes. He explains: "When a pile of river sand has been left for a long time exposed to rains, the ground, at first scarcely visible, becomes in time even more conspicuous than the sand itself, because the sand is wasted and borne away, leaving the heavier masses of gravel. The ceaseless dashing of a lake stirs up the finer material of the drift which rests beneath the waters. This passes off as sediment at the time of the overflow, leaving the gravel and boulders strewn abundantly upon its bed. The lakes are generally

shallow and the water in them low in autumn, so that at the approach of winter it is frozen to the bottom over a wide margin from the shore." Prof. White states that the walled lake of Wright county a few years ago was entirely frozen and the fish killed, but since partly re-stocked by the fry reaching it by way of the outlet to the rivers at the time of the overflow.

The ice of course freezes to everything upon the bottom, whether boulders, sand, gravel or mud, and the expansive power of the water in the act of freezing is exerted upon them, acting from the center of the lake in all directlons to its circumference. Of course it would not be expected that one winter's freezing would bear these boulders to the shore, but it is continued winter after winter, until finally they approach the margin of the lake and repose around it jnst above high-water mark, forming a ridge just where the expansive power of the water ceased, as shown in many Iowa drift lakes. The tracks of the moving boulders have been observed. Below the line of freezing the boulders would remain unmoved on the bottom.

The embankments vary in height from two to ten feet, and from five to twenty feet or thirty feet across the top, their size varying according to the materials which compose it.

The embankments are often largest on sides opposite to the prevailing winds. Prof. White winds up by saying: "The same material force that brought the boulders down from their northern home, also placed them in the embankments of those lakes, namely, the expansive power of ice." Yours,

G. C. BROADHEAD.

SCIENCE LETTER.

PARIS, December 23, 1878.

The Exhibition, in the matter of domestic heating and lighting, has supplied us neither with anything new nor, indeed, improved, although no end of patents have been taken out, boasting to effect economy in combustion and efficiency in the distribution of heat. Old processes have been brushed up, it is true, but the problem of successful warming of habitations remains unsolved. The ninety-five per cent of heat produced in a fire-place escapes still by the chimney, or, if it is retained in a room to the extent of seventy-five per cent, there is danger of our being suffocated with impure air. Imagine the waste of caloric in a city like Paris, estimated to have 150,000 chimneys. Russia and England displayed very beautiful stoves, but the perfect apparatus was not the less wanting. It is admitted that for a bedroom a chimney is a necessity, but for halls, stair-cases, etc., a stove suffices, provided it be so constructed that the iron shall not acquire a temperature so elevated as to attract the organic particles or germs floating in the atmosphere, and by decomposing them generate that oxide of carbon to be inhaled by us, and thus perhaps profoundly alter the condition of the blood, since Dr. Gréhant has recently demonstrated what poisonous effects an imperceptible trace of that oxide

in the air can produce. Of the boastings to heat large apartments for three sous a day, the public, remembering the price of combustibles, knows full well that from nothing, nothing can be obtained. We waste instead of economizing heat. Dr. Paquelin has applied platina to the production of a constant and high temperature. The system is not new. Platina has the property of condensing gases and vapors, and in proportion as its surface is divided and the temperature elevated. By means of a blow-pipe it can be made incandescent. Dr. Paquelin has made cauterizing instruments, which are easily retained at a uniform somber red, during the performance of his operations, the metal employed being platina, and gas the heating agent preferred. He shows a furnace where inside an iron tube is placed a platina wire, surrounded with stuffings of the same; mineral oil, mixed with air, is blown to the interior, and a heat generated fifty times greater than that of the furnace of a locomotive, and not costing more than 4 centimes—less than a half-penny—per hour.

This apparatus, if the blowing on the wire be augmented, will change the latter from a red to a white heat, and thus obtain a very superior and fixed light. But the jet must be regulated to prevent the melting of the platina. Thus by a mixture of gas and air, or of air and a carbureted vapor, a light can be obtained much superior to that from ordinary gas, and better than that from electricity, as it is from the disagreeable flashes of varied brilliancy. M. Lascols' instantaneous gas is also and old idea, and, if he can obtain its circulation over reasonably long distances, his plan ought to be invaluable for lighting villas, castles and workshops. He can feed several dozen burners. By means of a bellows he drives air into a gas metre at the rate of 1000 quarts in two minutes; thus stored up the air, under a slight water pressure, passes into a reservoir containing mineral essence sufficient to feed fifty nibs during nine hours. By turning a cock, a beautiful flame escapes, lighting with a brilliancy equal to eight candles, and at a cost of a half-penny per hour. There is room clearly for Messrs. Paquelin and Lascols to unite their efforts.

The electric light has made no progress since last year; it is only economical when employed on a vast scale to light up extensive spaces. The sticks of carbon have to be renewed each evening, and this plan, to all appearances, must be continued till Edison produces his platina wicks. Messrs. Dronier and Voisin desire to supersede lucifer matches. When a current of electricity is passed along a platina wire, the latter becomes hot and red; if a lamp containing mineral oil be brought, its vapors, coming in contact with the wire, will be instantly ignited. The pile of Messrs. Dronier and Voisin is powerful and condensed, can be held in the hand and charged every two or three minutes. Such is their *allumeur*.

The prevalence of typhoid fever in French barracks, and the havoc it makes among the young soldiers, gives much occupation to scientific men. Ordinary typhus fever, the consequence of overcrowded habitations, want and general misery, is almost unknown in France. The social condition of the people bars out that epidemic. Not so typhoid, which spares the very young and the very aged, and strikes down the flower of youth and the prime of manhood, indifferent to rank or calling.

The characteristic of typhoid fever consists in the lesions or ulcerations of the intestines, as first pointed out by Spieghel, of Holland, the same doctor who protested against swaddling clothes for infants. It was a Frenchman, Dr. Louis, who in 1829 first employed the term "typhoid"—analogous to, but, as we now know, very distinct from, typhus fever. No remedy has been found for typhoid fever; all science can do is to aid the body by fortifying it to resist the disease and to expel its venomous elements. But man can, by sanitary ameliorations diminish the causes that favor the development, if not produce the disease itself. Continental doctors believe that typhoid fever is both contagious and spontaneous the latter term being employed to cover inability to account for the origin of the disease. There is no doubt the fever is the offspring of a germ, the latter in turn being an excrementitious product, or emanating from the surroundings of a patient, and disseminated by the usual channels of contact, the germ developing when in presence of its peculiar hygienic conditions. We know this germ only by its effects; we are still ignorant of its nature. It is a decomposing matter, suspected of belonging to the class of parisites that produce ferments, such as changing sugar into alcohol or lactic acid, wine into vinegar; and in the case of carbuncle, rot and kindred affections, analgous animalcules have been found. Marshes, sewers, cess-pool emanations, etc., are fruitful sources of typhoid fever, and the track of death is visible following the direction which these currents of contagion take. An insect is often the medium for conveying the disease-seed. Note, however, these facts. Dr. Klein has tried to communicate typhoid fever to monkeys by mixing with their food detritus from a patient; the cess-pool and sewrage men of Paris do not suffer from any typhoid fever, and the cess-pools of this city, cleaned but once a year, have an open grating in the court-yard to allow the noxious gases to escape. In typhoid fever the patient succumbs from the rapid consumption of the tissues, the debris of which float in, while poisoning the blood; when the poisoning reaches the head, stupor ensues, next delirium, then coma, followed by death.

Some confusion exists in the minds of many persons that the solar apparatus exhibited on the Trocaden by M. Monchot, and by means of which he cooked beefsteaks, boiled water to drive a steam pump, to distill cognac, and to manufacture ice, is the same in principle as the burning mirrors or lens of Euclid, Archimedes, De Magini, Buffon, etc. The lens consumed the combustible in a single spot, where the solar rays were reflected and concentrated, and the temperature was so elevated as to melt copper in a few seconds, and burn a hole in a steel spring in nine. The caloric was too intense, too localized, in this case to serve any industrial use; it would fuse in a minute any metal vase, and instantly calcine meats. The sun's rays impart a vast quantity of heat to us, but it is rapidly disseminated and absorbed; the sum of solar heat often equals, per square yard, a quantity sufficient to heat in one minute a quart of water sixty-two degrees Fah. It is for us to capture and imprison it. The gardener does so by his bell glasses. Saussure and Herschel invented the solar pot; the latter, at the Cape of Good Hope, prepared soup in this way. M. Mouchot constructs a reflector, in shape

like an ordinary lamp-shade, and turns the conical mouth to the sun; on the axis of the reflector is an elongated boiler, composed of two envelopes, one for the water, the other for the steam, and both covered with a glass cylinder. This apparatus imprisons the sun's rays when placed at an angle following latitude, and turning with the sun by means of a clock-work movement. There are smaller reflectors, one-fifth of a square yard in surface, that cook two pounds of beef in twenty-two minutes, and that will heat a stove in ninety minutes which would require four hours of an ordinary wood-fire to effect. So late as the 2d of September the grand reflector boiled its seventy quarts of water in half an hour, and in a shorter period, by means of the Carré machine, turned out a respectable block of ice on the principle of evaporation producing cold—one of the objects in watering the streets during summer. There are latitudes, here for example, where the solar receiver would be useless; but as wind-mills are of value in some countries—the coast of Holland for example, so are tropical regions where coal is rare, and sunshine a glut—the Monchot invention might find employment.

The great fishing bank of Newfoundland is equal in extent to one-half the surface of France, and of an average depth of from three to four fathoms. What distinguishes the navigation of the region is that all the dangers of the sea and the atmosphere are there united; the southern winds that there dominate throw over the banks the warm vapors of the Gulf stream, which, encountering polar currents, condense and form a permanent haze, tempered with dense fogs, to be dissipated only by strong northerly or westerly winds. For the same reason, by the shock of waters which takes place, animal matters accumulate, form food, and marine life concentrates there, to devour and to be devoured. Unable to take astronomical observations from a concealed sun—but whose influence not the less dries the fish—and the compass being deranged from a greater proximity to the pole, Vice-Admiral Clone, who commanded several years on the station, has drawn up a handy book called the *Pilote*, being a series of methodical soundings; by following the instructions laid down and constantly heaving the lead, a captain can feel his way as safely as a blind man on shore with a stick.

In the Cevennes, Upper Italy, Bayonne, and even the Azores, the chestnut trees, which are veritable "bread-fruits" for the population, are dying off, the most vigorous in the course of two or three years. The branches wither from the tips, and a dry-rot eats inward toward the trunk. Around the roots is a kind of humid gangrene, sweating a kind of liquid which blackens the soil; this inky color, however, can be produced by the tannin, which the tree contains, coming in contact with salts in the soil. On close examination, a fungus or mushroom will be found to have entwined the roots, stretching its filaments in the new wood of the trunk and branches, and true parasite, living on the sap. The malady is contagious, and recalls the mulberry disease of fifty years ago. Now, all these symptoms coincide with the premature death of the trees on the boulevards of this city, and beneath the grating which runs around the trunks quite a "bed" of venomous mushrooms are ever to be found. The usual explanation given for the perishing of the trees in Paris is the gas pipes and the baking of the ground

by the passing vehicles. But in the exterior boulevards, where gas pipes are as rare as constant traffic, trees decay from their branches inward before their time.

M. Duponchel, in his survey, or rather general investigation, of a proposed grand trunk railway from Algeria to Soudan—the Central African, in a word—has gathered some facts curious for science, though perhaps not likely to catch shareholders. Soudan is just as unknown to Algeria as to France, though there was an active trade carried on between the two countries up to the period of the conquest of Algeria by the French; at present not a person can be found to indicate the routes of the caravansarie. The granitic is the prevailing formation of the Sahara—the latter being an Arab word meaning a soil rocky, hard and resisting; there are also paleozoic and carboniferous beds, justifying the existence of coal, which is totally wanting in Algeria. Railway travelers will be able to enjoy the splendid mirages; they must not expect much vegetation, as this is impossible in consequence of the owners of the air; rain falls, but it is as rapidly evaporated, and the midnight radiation is intense. This projected railway will interfere with the plan of converting the Sahara—of which only one-ninth of the surface is in sandy *dunes*—into a sea, its supposed pristine state.

Dr. Blanche, the most famous alienist living, has published a work on dangerous madness, more especially "devoted to those lunatics that kill." He concludes that there is no special form of mental alienation that justifies the name of homicidial monomania; that homicide is only the result of an excitement, which may take place following very different pathologic conditions. Alcoholism and epilepsy represent the maladies where mental perversion most frequently impels to homicide.

Dr. Guerin introduced to the Academy of Sciences a young lady whom he cured five years ago of tubercular consumption. It is the absence of vitality in the lungs that leads to the tubercular deposits; he acts on the thorax by slightly firing the skin near the region of the affected lung, which stimulates it to action. The "fire douche," not painful, is made twice a week, followed with saline and bark preparations.

SCIENTIFIC MISCELLANY.

TELEGRAPHY WITHOUT WIRES.

Mention was made in this correspondence some time ago of the experiments that are being made by Prof. Loomis, of this city, in the mountains of West Virginia, to demonstrate his aerial telegraphy. He claims, it will be remembered, that he can telegraph from one part of the country or world to another without the use of connecting wires, except those that he needs to reach up to a certain altitude, where his experiments have shown that there is at all times a natural current of electricity.

His experiments are conducted from high hills or mountains, though he has

telegraphed as far as eleven miles by having kites raised at each end of that distance, flying them with a fine copper wire instead of string. The instant they reached the same exact altitude or got into the same current telegraphic communication, by aid of an instrument similar to the Morse instrument. could be carried on as perfectly as if the two kites were connected by wires. The lowering of one kite would, however, break off the communication immediately. This demonstrated to the professor that his wires should be stationary to keep constant communication.

Accordingly he built a kind of telegraphic tower at the tops of two hills about twenty miles distant, and from them put up a steel rod by which a certain aerial current of electricity was reached. For months at a time he has been able to telegraph from one tower to another. A heavy storm disarranges the connection, but it can be readily restored after the storm has passed. In this respect, however, it is not more unreliable than the ordinary telegraph connections by wire, which are broken up by many storms.

A letter was received from Prof. Loomis some days since by Mr. D C. Forney, of the *Sunday Chronicle*, in which he said that recently he had met with the most remarkable success in his experiments, and had demonstrated by repeated tests that the telephone could be used as easily as the Morse instrument, and that lately he had done all his talking to his assistant, twenty miles away from him, by the telephone, the connection being aerial only.

He added that he had been in correspondence with Edison for a long time, and that he had received many valuable hints from him, and that Edison had been fully convinced for a long time that aerial telegraphy was practicable, and had so expressed himself to him frequently. Edison also thinks that his aerophone can be worked by the same means. It will be readily seen that if telegraphing can be carried on without wires, according to the idea of Prof. Loomis, the expense of the same will be reduced to almost nothing in comparison to the cost of building and keeping telegraph lines in order under the present system.

THE HEAVENS IN FEBRUARY.

Every one who has watched the heavens during January has noticed a gradual shifting of the stars towards the west. Constellations which at the commencement of darkness in the beginning of the month were at an elevation of one-third of the distance from the western horizon to the point overhead are no longer seen, while others, which, at the same period were invisible, have come into view in the East. This movement of the heavens in a western direction is caused by the revolution of the earth around the sun toward the eastern point of the horizon. The sun, though situated at a distances of rather more than 91,000,000 miles, is yet, comparatively, so near that the advance of the earth in its orbit causes the central luminary to appear in different parts of the heavens, while the stars are at such immense distance that even a change of position equal to double the interval between the earth and the sun makes no perceptible variation in their apparent place. Day and night are due to portions of the earth being

turned by its diurnal revolution towards or from the sun, and the increasing or decreasing length of the day causes the stars to be seen in a different position when night renders them visible.

About the middle of February Aries, which is usually considered the first constellation of the zodiac, or of those along the apparent path of the sun among the stars, will be near the western horizon. Aldebaran, a red star in Taurus, and one of the Hyades at 10 o'clock, will be about forty-five degrees high, while Castor and Pollux, in Gemini, will be near the meridian or great circle passing north and south through the zenith or point overhead. Regulus, in Leo, will be about twenty-five degrees from the meridian, and Spica, the bright star in Virgo, and, like Pollux, Aldebaran and Regulus, one of those from which the moon's distance is measured, will just appear in the east. Sirius, "leader of the starry host," will be a little past the meridian; Betetguex and Rigel in Orion, about forty degrees high. Arcturus, in the constellation Boötes, the brightest star visible during the summer months, will be short distance above the eastern horizon. Perseus will be rather low down in the northwest, and Berenice's Hair, conspicuous in the northeast by east, and Capella about sixty degrees high.

As the stars rise an hour earlier every fortnight, their positions at the same time of night vary in that period fifteen degrees, or one-sixth of the distance from the meridian to the horizon. It is therefore only approximately that the places of the brighter stars can be given during the whole month.

Of the planets visible without the aid of a telescope Mercury will be too near to the sun to be observed. Venus will continue to be the evening star, setting each night at a later period and increasing in brightness. Mars will rise about an hour before the sun on the 9th and will be visible a little earlier every morning the remainder of the month, This planet will be in opposition to the sun the second week in November. At such times it is nearest to the earth and shines with the greatest brilliancy. Jupiter will cease to be the evening star after the 7th of the month, and on the 15th will rise a few minutes before the sun, and continue to be the morning star until the close of August. Saturn is approaching its conjunction with the sun. It will set at the beginning of the month a little after 9 o'clock, and may be noticed as a palish star in the southwest. Uranus, which may be observed by a practiced eye shining with a faint blue light, will rise about sunset the middle of the month. It will be near to the waning moon on the 26th and will be visible the whole night. As this planet makes but one revolution around the sun while the earth makes eighty-four, it appears during seven years to rise and set in the same constellation.

Two occultations of stars by the moon will take place in February—one of a star of the fifth magnitude in Scorpio on the evening of the 10th, and another of a small star in Taurus about an hour and a half after sunset on the 28th. The moon will be too near full for the first occultation to be viewed with advantage; the disappearance of the last may be observed at the dark edge of the planet.

The nightly sky during February will be adorned by many of the most beautiful constellations. Stars which have been carefully observed from the days of the

shepherd astronomers of Chaldea to the present time will be visible during the whole or the greater part of every night. Although a majority of the most conspicuous stars are colorless, there are some which present a different aspect. Capella emits an orange, Aldebaran a red, Arcturus a yellow, and Vega a blue light. Sirius, which now appears white, except in certain conditions of the atmosphere, when it has a slightly bluish tinge, was regarded by the ancients as a red star, and it is so called by Ptolemy and Seneca. When it is recollected that each of the colored stars is a sun, which probably gives light and heat to opaque bodies like the earth, imagination fails to picture the hues of a landscape or the tints of the sky on a planet illumined by a red, a blue or a yellow sun. It is also equally at fault in assigning plausible causes for the variation in the color of those "suns of other systems" from the appearance of the central luminary around which the earth makes its annual circuit in its progress through space.

—*Philadelphia Times*.

MAN'S EVOLUTION.

INSPIRED BY THE "FINE OLD ENGLISH GENTLEMAN."

There was a time, devoid of life, devoid of sense or motion,
When nothing stirred—no leaf, no bird, no beast, no fish, no ocean—
Yet, somehow or other, things mixing together, atoms went into spasms and brought forth protoplasms.
Then sprouted, too, the monkey-man
Of the old Silurian time.

For "cellulous growth" a-working put "to" upon a "pro,"
And "to" and "pro" together combined into "proto,"
Then "proto" with its gaping mouth takes root upon a "plasm,"
And altogether added up somehow turned protoplasms
Into the fine old ancient gentleman,
Of the ante-diluvian time.

His brow was low, his fur was long, his claws had grip of steel,
He roared at megatheriums with uncouth grunt and squeal,
He walked erect or ran about as pleased him, on all fours,
And never a house had he in his life, but lived all the time out of doors—
Did this fine old active gentleman
Of those queer Silurian times.

'Twixt him and his spouse there used to be rows
Which frightened strange beasts to their lairs;
For he'd bang her about with howl and with shout, and pull out her bristly hairs,
And chase her down caves and up into trees, and "paste her delicate snoot."
Thus woman oppressed had her rights first suppressed
By mere physical strength of this brute,

This fine old furry gentleman
Of disorderly miocene times.
Wider his range of appetite the faster he progressed,
He shed his fur, grew tender-skinned, in other skins then dressed.
Cut by sharp flint, he took the hint, and made him knives and spears,
With which he stabbed his fellow-man and skinned the fallen deer.
Unlucky once upon a chase he saw the timid rabbit
Pounced on by wolf, but he was there exact in time to grab it;
And here we see he got an "idee," for the wolf he trained to hunt,
And ever since of sportsman's toil the hound has borne the brunt.

Countless cycles passed away, and then electric flashes,
Consuming woods and game at once, roast meat laid in the ashes,
Which, smelling around, he finally found, and hungry he did eat;
It tasted good, 'twas understood henceforth that roasted meat
Would suit prehensile gentlemen
Of the old post-pliocene time.

The more front brain he grew the more then he knew, and kept on developing "gumption;"
Oft changing his place, his wits grew apace, and with them his demand for consumption;
So to lighten his labors, he stole from his neighbors,
And the pith of the joke is, he called all his tricks his, lawful, correct and legitimate biz-niz!
Did this greatly developed gorilla
Evoluted from pliocene times.

'Tis only a few thousand years since he learned to read and write,
And post his recent history up, as he thinks correct and right,
And fast his angry tongue will wag, and loud his bitter wail,
When told of his progenitors, who by wholesale were re-tailed—
Such a vain, conceited gentleman,
Is he of modern times.

His knowledge now is vast and deep of germs and protoplasms,
Of cosmics here and psychics there, ozones and microcosms.
His science, many syllabled, it strikes one with a thud,
And makes eternal mysteries, as ever—clear as mud!
To the fine old rudimentless man
Of the present high old times.

—*New York Graphic.*

VALUABLE MINERALS IN SAN JUAN.

We have been agreeably surprised with the collection of valuable metallic bearing ores and mineral specimens just opened at 93 Fifth avenue, as received from the great San Juan Mining District of Colorado, and being the property of the recently incorporated Big Giant Silver Mining Company of this city. These specimens are evidently from extensive outcroppings, and give clear and distinct evidence of true fissure veins and ledges. The ores generally are of quartz, porphyry, and feldspar gangue, the metallic contents are as usual in combination with sulphur and oxyds of iron, copper (gray copper) held in finely disseminated atoms. The veins at a greater depth invariably terminate in galeniferous ores, in which the silver largely predominates. Some of these ores contain silver in the metallic state, which is readily visible to the naked eye. It is quite evident that these ores bear a strong resemblance to the famous silver mines of Mexico in the Sierra Madre regions, which have been worked for the past 300 years, and from which many millions have been realized by the British shareholders, as may be read in Jacob's History of Mexico and its Metallic Resources. The San Juan District is of the same upheaval in a geological sense, and is destined to become the great argentiferous emporium of the American continent.—*Occident.*

THE TENDENCY OF MODERN SCIENCE.

In his address at the Harvard commencement exercises recently, Principal Dawson, of McGill College, Montreal, spoke eloquently, but in a vein of modesty rarely equaled by his brothers in science. Mr. Dawson, in the course of his address, said: "There is a temptation in science to attempt an explanation of everything, but the honest way would be to acknowledge frankly its inability to solve the mysteries attaching to certain phenomena. It is a temptation also of scientific men to be drawn toward a materialistic view of nature and man." In thus speaking the learned Professor struck the very key-note of that revolution against the imperiousness of science as at present expounded, which is impending over the whole world of thought. Men of science, like Huxley and Tyndall, for instance, seem to have combined to place literature and history in a position inferior to their own special studies. Huxley has said in effect that the study of the vibriones, and all the remains of the animalculæ, which are the foundation of the bed of the ocean and the chalk cliffs which so often girdle it, are of more importance than any investigation of the habits and history of the great races of antiquity, of the Assyrians, the Egyptians, and their successors in the onward march of civilization among the nations. To judge from many of his works, Tyndall seems to think that the observation of different forms of crystallization is far more momentous than any inquiry into the literature of the Greeks, the polity of Rome or the commercial enterprise of the Carthaginians. In a word, as Mr. Dawson hints, the tendency of all modern science is decidedly in the direction of a cold

utilitarian materialism. It leads men to examine, with the closest attention, not the past and present condition of man *in se* and *per se*, but those forms of inanimate nature or the brute animals, over all of which dominion was given to the human race at the creation. There is, as Tyndall says, infinite poetry even in the dryest details of chemistry and all other subjects of the pursuit of the knowledge of matter. But man, "splendid in ashes, pompous in the tomb," as Sir Thomas Browne says in the *Religio Medici*, is greater than all these. Pope, in many respects one of the greatest figures in the age of Ann, was wiser than these Solomons of science when he wrote: "The proper study of mankind is man."—*Globe-Democrat.*

THE GREAT BRIDGE IN SCOTLAND.

The railway bridge across the Tay, at Dundee, the formal opening of which was celebrated on Friday last with quite warrantable rejoicings, can hardly fail to produce a great effect upon the commerce and manufactures of the northeast of Scotland. Dundee is no longer isolated, and the Firth of Tay, in as far as the railway system is concerned, has been practically abolished. It only remains now to bridge the Forth at Queensferry—a project which has been for some time resolved on—and then the linen stuffs of Borfarshire and Fife, and the farm produce of Aberdeenshire will be brought directly and in an unbroken line within reach of the southern markets. To travelers the through route would be an immense boon, as it would both save time and remove the discomfort of frequent changes.

One of the two ferries that lie between Edinburgh and Dundee has now been superseded, and in such a way as makes it certain that the speedy removal of the other and longer one will be felt to be a pressing necessity. The Tay bridge, however, has something more than a merely local interest. As a triumph of engineering skill and well-directed energy and perseverance, it is worthy of—as, indeed, it has already attracted—very general attention. It is certainly the longest bridge of its kind in the world, and that is a thing of which its projectors and makers are quite entitled to be proud. There are longer viaducts over meadows and marshes, but there is no structure of nearly the same length over a running stream. Its length may be stated broadly at two miles. Including the extension on the northern shore, the exact length is 10,612 feet—that is to say, it is longer than the Victoria bridge, Montreal, and the Britannia tubular bridge taken together. This great length is taken in 85 spans of varying width, the widest (of which there are eleven) being 245 feet. The level at the shore is between 70 and 80 feet above the sea; in the middle it is 130 feet above high-water mark. The skill displayed in a work of this kind is proportioned to the difficulties that were encountered and overcome; and in this view the engineers of the Tay bridge are entitled to the highest praise. In many respects their resources were put to a severe test, but on no point have they failed. The greatest difficulty that met them arose from the varying character of the bed of the river, which compelled them to adapt both the foundation and the superstructure of their piers to the dif-

ferent conditions that pres nted themselves. Near the shores the rocky bed was easily reached, and on it piers were raised built out of brick throughout. Further out it was found that the rock suddenly shelved away to a great depth under clay and gravel. There the cylinders, filled with concrete, which form the foundation, were made of much greater diameter, and above the high-water level iron pillars were substituted for brick. The lattice work girders, as well as the cylinders, were prepared on shore, and were floated out on rafts to their position. The only serious accident that occurred in connection with the undertaking was the bursting of a cylinder within which men were excavating; the water rushed in, and six of the workmen were drowned. The platform on top of the bridge, which carries the single line of rails, is only fifteen feet wide. The bridge does not form a straight line; toward the north end it curves eastward to Dundee. The whole structure has a remarkably light and graceful appearance. It is so long, so lofty, and yet so narrow, that when seen from the heights above Newport it looks like a mere cable swung from shore to shore; and seeing a train puffing along it for the first time excited the same kind of nervousness as must have been felt by those who watched Blondin crossing the Niagara. Fragile as its appearance is, however, there is no doubt of its thorough stability. The total cost of the bridge was £350,000. The cost of the Britannia tubular bridge, which, however, has a double line of rails, was £601,865. The Tay bridge was designed by Mr. Thomas Bouch, C. E. Mr. A. Grothe was the superintending engineer, and the contractors were Messrs. Hopkins, Gilkes & Co., of Middlesborough. Mr. Bouch is at present completing his plans for the Forth bridge at Queensferry. The great difficulty to be overcome there is the enormous depth of water. The width of the strait is more than a mile and a quarter, and almost the only foundation for piers that can be counted on is a small island near the northern shore. The girders in this case must be of unprecedented length.—*London Times.*

HOT LAKES IN NEW ZEALAND.

After a substantial colonial breakfast, consisting of mutton in various forms, we went down a winding path to the lake, and found that the chief to whom we had applied had supplied us with a substantial, English-built boat and a crew of six men, who did no injustice to the Maori fame for stature and strength. We at once embarked, and in less than two hours we landed on the other side. The warm stream that flowed from the hot lake above was too rapid to contend against in anything but light canoes, and having laden two of the crew with our luncheon and rugs, we proceeded to walk the remaining mile to the White Terraces. The scenery already was pretty enough, but we were quite unprepared for the wonderfully beautiful sight which suddenly burst upon us as we turned the last corner. A vast marble staircase rose above us streaming with water. At the summit

a cloud of steam came rolling slowly up from some gigantic boiling pool and floated away among the hills.

We were soon at the foot of the hill, and a nearer inspection only enhanced its beauty. The broad, flat steps were worn by the action of sulphuretted water into an exact imitation of white coral, and on every platform rested a basin of the bluest, clearest water. As each of these was filled from the basin above, it overflowed into the basin below, and from being at boiling point at the top the water became almost cold at the bottom. The pool was almost regularly circular and hollow by nature, so exactly that its sides might compare favorably with the best paved bath in London. A mass of clear, blue water writhed and tumbled within, now rising with a burst to the height of some twenty feet, now sinking into a furious whirlpool.

Among the various explorations in the arctic regions prosecuted during the year 1878, not the least interesting and important is that of Lieutenant Jensen, of the Danish navy, in Greenland. As long ago as 1751, Dalager, who made an expedition to Fredrikshaab, reported that far to the east he observed a series of mountain peaks, which he supposed to be the eastern coast of Greenland. Several attempts have been made to reach these mountains, and to confirm or disprove the supposition; but it was not until the present year that this was accomplished. Lieutenant Jensen, with three Danes and one Greenlander, entered the ice-fields on the 14th of July, dragging their provisions and instruments on three small sledges. After very great vicissitudes the party finally succeeded in reaching the mountains, and in ascending the highest of them on the 31st of July. Its altitude proved to be about 5,000 feet above the level of the sea, and the vision swept over ice-fields and hommocks to an indefinite distance, showing conclusively that this was not the eastern coast of Greenland, as had been imagined.

The summit of the mountain ascended by Lieutenant Jensen was bare, thus, according to Mr. Robert Brown, establishing the interesting fact that there are peaks in the interior so high that the great ice sheet has not been able to cover them. He also states that there are no grounds for believing that the inland ice of Greenland comes, like ordinary glaciers, from mountain ranges.

Johannesen, a well-known Norwegian walrus-hunter, has lately discovered a new island, due north of the Yenisei River, in longitude 81° E. and latitude 77° 55′. This is quite flat, and about twelve miles long, with its highest point about one hundred feet above the sea-level. No snow was discerned on the island, which was provided with scanty vegetation, but frequented by innumerable birds. The fact that the sea was free from ice to the west, north and east, and the occurrence of certain types of animal life, suggests the idea that the Gulf Stream reaches the western side of the island. The island, which Johannesen named "Ensomhaden" (*Loneliness*), is almost due east of Francis Joseph Land, and is thought to be a part of the same archipelago.

EDITORIAL NOTES.

THE Kansas City Academy of Science was addressed at its last meeting, January 28, by Prof. C. E. Robins, of Colorado, whose very entertaining paper upon "Life at the Timber Line" will be found in this number of the REVIEW.

Mr. A. Greeley also read a very interesting essay upon "Human Progress," which evidenced deep and extensive research and an unusually perspicuous and elegant style of composition. The positions taken by him were freely discussed by Prof. Parker, Dr. Halley and others.

Mr. Wm. Lykins presented to the Academy about fifty volumes of bound and unbound scientific magazines and pamphlets, which were accepted with a vote of thanks.

THE Kansas State Historical Society elected as a Board of Directors: S. A. Kingman, C. Robinson, D. R. Anthony, C. K. Holliday, J. C. Hebbard, D. W. Wilder, G. A. Crawford, J. A. Martin, Sol. Miller, E. N. Morrill, Jacob Stotler, F. P. Baker, F. G. Adams, J. P. St. John, John Francis, A. H. Horton, P. I. Bonebrake, T. D. Thacher, B. F. Simpson, J. F. Legate, John Speer, S. N. Wood, M. W. Reynolds, J. L. McDowell, J. M. Harvey, P. B. Plumb, J. J. Ingalls, W. A. Phillips, D. R. Smith, Chas. W. Leonhart, D. E. Ballard, W. W. Guthrie, George Graham, James Blood, A. G, Barrett, Robert Crozier.

Gov. Chas. Robinson, who selected the town site of Lawrence for the first organized party that ever came to Kansas, was unanimously elected President.

D. R. Anthony, who a quarter of a century ago conducted the original party from the East to Lawrence, was chosen one of the Vice-Presidents, and Col. C. K. Holliday, one of the earliest pioneers, and who did able service for the people of Kansas, was also chosen Vice-President. F. G. Adams, the efficient Secretary, was unanimously re-elected Secretary, and John Francis Treasurer.

THE report of the Entomological Commission, consisting of Profs. Riley, Packard and Thomas, is a monument of patient study and scientific accuracy, of which the authors may be proud, and for which the whole country may rejoice. It is the result of only one year's work, but it goes so far to determine the habits of the Rocky Mountain locust and to specify means for its extermination, that little more seems to remain possible to be done.

PROFESSOR BERTHOUD, of the Colorado School of Mines, at Golden, Col., writes us that "it is proposed to have a vacation course this summer, in which the students will visit, besides the pleasure resorts, all of the principal mines and works in the State, remaining long enough at each for thorough instruction in the details of the various mining and metallurgical processes. This course will be under the immediate direction of the Professor in charge, and of the Professor of Geology. An endeavor to obtain special excursion rates on the various railroads over which the students will travel will be made, in order to render the expense of this trip as small as possible. The course will be open to others than those who are students at the Institution, and any one desirous of taking the excursion without pursuing the regular course of studies in the school, may do so. This offers an excellent opportunity to students in the Eastern colleges to spend their vacation in a manner which will be both agreeable and of benefit."

A CONVENIENT HAND-CAR.—A light hand-car built by the Westinghouse Air-brake Company has been named the "Quadricycle." It weighs 350 pounds; the rear wheels, or drivers, are four feet in diameter, and the pilot-wheels two feet in diameter—these latter being purposely made small to keep the vehicle on the track, and to enable the rider to lift the front end and drag it from the track quickly in the event of meeting a train. One has been running for a month or two between Steubenville Junction, on the Pittsburg, Cincinnati & St. Louis Railway, and Wheeling, a distance

of twenty-seven miles, which it makes at an average speed of ten and a half to twelve miles per hour, carrying sixty pounds of newspapers. Instead of being worked by a crank or cranks by one or more persons, this machine is worked by a cross-bar, from which levers extend to each of the four wheels. The applicative hand-power is very effective, and makes a single person accomplish handsome results in fairly-tested transportation of himself, and with him considerable weight.

PROF. B. F. MUDGE, the well known Geologist and Palæontologist of Kansas, returned a few days since from a lecture tour In New England to his home at Manhattan, stopping a few hours only in this city.

THE citizens of Penzance, England, celebrated the birthday of Sir Humphrey Davy on the 13th inst. with appropriate ceremonies and a display of scientific apparatus and electric lights.

THE Congressmen from Kansas and Colorado are earnestly opposing the geodetic survey recommended by the National Academy of Science.

NOTES ON THE PERIODICALS.

THE *London Quarterly Journal of Science* does us the honor to republish from the November issue of the REVIEW the now widely-read article on "Peruvian Antiquities," by Dr. E. R. Heath, of our sister city, Wyandotte, Kansas.

This able and long established journal is to be changed with the next number from a Quarterly to a Monthly and its scope extended so as to include new branches and divisions of science and enable it to keep more nearly abreast with the progress of scientific research and discovery.

Popular Science Monthly for February contains: Darwin *vs.* Galiani, by Prof. Emil Du Bois-Reymond; Scientific Relation of Sociology to Biology, II, by Prof. Joseph Le Conte; The Crystallization of Gold, Silver and other Metals, by Thomas J. Gregan (Illustrated); Herbert Spencer before the English Copyright Commission, II; The Formation of Mountains (Illustrated); Planetary Rings and New Stars, by Prof. Daniel Vaughn; The Old Phrenology and the New, by Dr. Andrew Wilson (Illust'd). Backgammon among the Aztecs, by Edward B. Tylor; Mites, Ticks and other Acari, by E. R. Leland (Illustrated); Typhoid Fever Poison, by Eli Van de Warker, M. D.; Sketch of Elisha Gray, by George B. Prescott (With Portrait); Correspondence; Editor's Table; Literary Notices; Popular Miscellany; Notes.

A. S. BARNES & CO. contradict the current report that Messrs. Lodge & Morse have bought the *International Review* and are about to remove it to Boston for publication, stating that they have not sold it to anyone, and that the arrangement with Messrs. Morse & Lodge is merely editorial-

THE *Atlantic* for March will give the first place to a paper of political and scientific interest, entitled the Natural History of Politics, which will be followed by an excellent short story; an essay on New York Theaters; an account of Unification in the Pitcairn Islands, by Mark Twain; an article on Electioneering in Congress for 1880; the conclusion of Mr. Howell's story; and other essays, tales and sketehes.

The February number contained reduced heliotype reproductions of the four life-sized portraits of distinguished American Poets, which are offered to subscribers and purchasers, for one dollar each. They are the work of Mr. J. E. Baker, one of the best crayon artists in America, and have received the hearty indorsements of such competent judges as Dr. O. W. Holmes, R. W. Emerson, C. D. Warner, T. B. Aldrich, G. W. Curtis, Bayard Taylor and others.

THE February number of the *North American Review* opens with an article by Senator Hoar on the Conduct of Business in Congress, which calls attention to the defects in the present system of transacting business in the national legislature, and suggests improved methods; A Statesman of the Colonial Era, by Gen. Richard Taylor, describes the career of George Mason, of Virginia, and attributes to that gentleman many sayings and writings

that have hitberto been credited to other men; Hon. D. H. Chamberlain writes on Reconstruction and the Negro, and presents the results of his experiences and observations while occupying the gubernatorial chair in South Carolina; the Scientific Work of the Howgate Expedition, by O. T. Sherman, of the scientific corps, gives a very full statement, and the only one that has been presented to the public, of the scientific results of the recent government preparatory expedition to the polar seas; Sensationalism in the Pulpit, by Rev. Dr. Taylor, of the Broadway Tabernacle, New York, a pungent criticism of the theatrical tendencies of certain preachers; and many other excellent articles.

Published at 551 Broadway, N. Y., and for sale by booksellers and newsdealers generally at 50 cents per copy.

HARPER'S MAGAZINE for March offers an unusual variety of matter to its million readers, while it contains no article that is not especially noteworthy; and its illustrations, of which there are eighty-five, are remarkable examples of the best style of wood-engraving. It contains, among other excellent things: Present Tendencies of American Art, S. G. W. Benjamin; A Few Sea Birds, H. W. Elliot; The Coast Survey, Martha J. Lamb; The English Home of the Washingtons, A. T. Story; Our Dutch Masters, I. Rembrandt Van Ryn, E. Mason; The Pine-Tree, a Poem, Harriet Spofford; Burg und Thal, Sketches in Tyrol (I.), George E. Waring, Jun.; English and American Locomotives, Charles Barnard; A Summer Story, Alice Perry; The English in India, Thomas Knox; Climates for Invalids, Dr. T. M. Coan; Gary's Magnetic Motor, E. M. Bacon; The "Tom" Side of Macaulay, D. D. Lloyd; Miss Morier's Nerves, a Story, Miss Thackeray; Afghanistan, Z. B. Gustafson; Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Scientific Record—Astronomy, Physics, Chemistry, Anthropology, Zoology, Engineering and Mechanics.

OUR friends of the *American Journal of Science* spell *loëss* with a diphthong, thus, *lœss.* Where they find authority for this we do not know. The derivation of the word is usually attributed to the German *lösz*, which gives apparent ground for the innovation, though no other scientific work has adopted it as far as we have observed.

THE *Price Current* of this city has issued its annual *Review* of the trade and commerce of this city in the shape of a handsomely printed pamphlet on tinted paper and filled with the most carefully prepared statistics of all the various branches of business carried on in Kansas City. Mr. Hasbrook, the compiler, and editor of the *Price Current*, has evidently given a great deal of time and careful study as well as arduous labor to its preparation, and it is a credit to him in every way, while at the same time it is a record of our business progress that every citizen may be proud to aid in distributing.

THE *American Antiquarian*, an illustrated quarterly journal, devoted to early American history, archeæology, and ethnology, edited by Rev. Stephen D. Peet, Ashtabula, Ohio; published by the Archæological Exchange Club, $2.00 per year or 50 cents each number, is the only magazine of the kind on the continent. The articles are all interesting and contain accounts of the latest discoveries. The illustrations are quite wonderful; they picture ancient things of which we now know but little. The researches are entirely reliable, as the list of contributors will show, viz: Dr. Charles Rau, D. C.; Dr. S. S. Haldeman, Pennsylvania; Prof. E. A. Barber, Pennsylvania; Prof. M. C. Read, Ohio; Col. C. Whittlesey, Ohio; C. C. Baldwin, Ohio; Wm. N. Byers, Colorado; F. F. Hilder, Missouri; Dr. J. D. Moody, Illinois; Hon. R. S. Robertson, Indiana; Col. L. J. Dupre, Texas; A. F. Berlin, Pennsylvania; Hon. C. C. Jones, Georgia; C. Berthoud, Dakota; E. F. Williams, Minnesota; Rev. H. F. Buckner. D. D., Indian Territory; Rev. M. Eells, Washington Territory; Prof. R. B. Anderson, Wisconsin; Hon. J. D. Baldwin, Massachusetts; L. Andrews, Connecticut; Hon. Bela Hubbard, Michigan.

Sunday Afternoon improves upon acquaintance, and we can give it a hearty recommendation to all who desire a good, high-toned intellectual Sunday magazine.

Of the many Guides and Seed and Plant Catalogues sent out by our seedsmen and nurserymen, and that are doing so much to inform the people and beautify and enrich our country, none is so beautiful, none so instructive as *Vick's Floral Guide.*

Books and Pamphlets Received:—*Public Libraries in the United States;* Parts I and II, being a report on their history, condition and management, by John Eaton, Commissioner of the Bureau of Education, Department of the Interior, Washinton, D. C. pp. 1187, octavo; *Report of the Commissioner of Education*, 1876, Parts I and II, by John Eaton, Commissioner: Government Printing Office. pp. 492; *Report of the Agricultural College* of Missouri, by Prof. G. C. Swallow; *Our National Waterways*, a speech of Hon. William Windom, of Minnesota, June 10, 1878, in the Senate of the United States; *B Lionis and B A. C.*, 3992, and *Note on the Duplicity of the Companion to Rigel*, by Prof. S. W. Burnham, of Chicago, reprinted from the monthly notices of the Royal Astronomical Society, May, 1878; *Catalogue of the Publications* of the U. S, Geological and Geographical Survey of the Territories, by Prof. F. V. Hayden, revised to Dec. 31, 1878; *Automatic Cerebration*, as related to cerebral localizations, by Prof. J. K. Bauduy, M. D., a discussion thereof in the Association of Medical Superintendents of the American Institutions for the Insane, St. Louis, 1878; *Chinese Exclusion*, speech of Hon. Jas. J. Ayers, Los Angeles Cal., Dec. 9, 1878; *Unconscious Tuition*, by Rt. Rev. F. D. Huntington, S. T. D., Bishop of Central New York, being the first of "School-room Classics," published by Davis Bardeen & Co., Syracuse, N. Y., pp. 45, 15 cents.; Some Early Notices of *Indians in Ohio*, and a discussion of the question, *To what Race did the Mound Builders belong?* by A. M. Force, pp. 75, octavo. Robert Clark & Co., Cincinnati. 50 cents.

Lindsay's Luck, by Mrs. Frances Hodgson Burnett, T. B. Peterson & Brothers, Philadelphia, is a charming tale, a delightfully fresh creation, pure in sentiment and action, full of force and dramatic power, and is a love story of the very best and purest kind. It will have a large sale, as its price is but 25c a copy. For sale by all booksellers and news agents, or copies of it will be sent to any one, to any place, post-paid, on remitting 25 cents in a letter to the publishers, T. B. Peterson & Brothers, Philadelphia, Pa., or to the Kansas City Book and News Co.

New Periodicals received, of which ample notice will be made hereafter: *Deutsche Geographische Blätter*, edited Dr. M. Linderman, Bremen. *Index Medicus*, a monthly classified record of the current medical literature of the world, compiled under the supervision of Dr. John S. Billings, U. S. A., and Dr. Robert Fletcher, M. R. C. S.; N. Y., F. Leypoldt; 72 pp, $3.00. *Our Schools*, a monthly journal devoted to the advancement of educational interests; Lawrence, Kansas; 60c per annum. *The Normal Courier*, edited by C. W. Stevenson, at the State Normal School, Warrensburg, Mo.; $1.00 per annum. *The New West*,, monthly, H. H. Allen, Atchison, Ks., editor; 60c. *Robinson's Epitome of Literature*, F. W. Robinson & Co., Philadelphia, devoted to literary criticism, art, music and the drama; $1.20. *Illustrated Scientific News*, S. H. Wales & Son, New York; semi-monthly; $1.00. *Carpentry and Building*, monthly; David Williams, New York; $1.20. *The Beacon*, monthly; Beacon Publishing Company, Philadelphia; 25c

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PREMIUMS TO SUBSCRIBERS.

We have determined to adopt a new, and, as we think, appropriate and acceptable plan for giving premiums to our subscribers, viz:

To any person who sends us $3.50, we will send the Review for one year and any $1.50 book published by D. Appleton & Co., S. C. Griggs & Co. Robert Clark & Co., Houghton, Osgood & Co., Roberts Bros., or J. B. Lippincott & Co.

To any one sending us $3.75, we will send the Review for one year and any $2.00 book published by any of the above.

Persons desiring to subscribe for the Review and purchase any book or books or subscribe for any other periodicals published or obtainable in this country, can obtain special rates by applying to the editor in person or by letter.

Clubs desirous of subscribing for the Review can have the same privilege as single individuals, besides the advantage of reduced rates of subscription.

To persons wishing to purchase law, medical, scientific or miscellaneous books, and at the same time subscribe for a periodical which includes within its scope popular articles upon all branches of science, mechanic arts and literature, we deem this a particularly favorable offer.

Back Numbers.—To any subscribers for the coming year we will furnish the back numbers of the first and second year for $2.25 each, bound, or $1.25 each unbound.

TESTIMONIALS.

As the second volume of the Review will close with the next number, March, 1879, and we shall be asking our friends to renew their subscriptions, it may be well enough for the first time in its history, and by way of showing the estimation in which it is held among scientific men and periodicals in different parts of the country, to publish extracts from some of the pleasant and encouraging letters and notices we have received. From them it will be observed that the Review has met with favor not less in the East than in the West, and that even in Europe it has found some readers of note who have been kind enough to express their appreciation of it and its management:

Washington, Jan. 20, 1879.

* * * * * * *

I look upon your Review as a very valuable addition to scientific journalism, and one especially interesting to the growing West.

Very truly yours,
H. W. Howgate, U. S. A.

St. Louis, Nov. 4, '78.

* * * * * * *

It will give me pleasure to do anything in my power to further your enterprise. Your journal is excellent and most creditable to yourself and the Great West, and much prized by your obedient servant, A. J. Conant.

Topeka, March 29, 1878.

* * * The Review is a very useful publication, and must contribute very sensibly to the material development of this section of the country, a record of whose history and development it is the object of this society to make up. Yours very truly, F. G. Adams,
Sec'y Kansas State Hist. Society.

Academy Natural Sciences,
Philadelphia, April 23, 1878.

I regret to-day that the March number of your valued journal has not been received at the Academy. Will you have the goodness to supply a copy, that our set may be kept complete? Yours truly,
Edw. J. Nolan, Sec'y.

Prof. E. T. Nelson, Wesleyan University, Delaware, Ohio, writes. Dec. 1, 1878, as follows:

"I have just read the November number of your monthly with great pleasure and profit. I did not know that so interesting a journal was published in the West."

Prof. O. T. Mason, Columbian College, D. C., the distinguished American anthropologist, writes, Jan. 20, 1879:

"I have frequently promised myself the pleasure of showing my appreciation of your very creditable journal by sending you something from the foreign field, &c."

Hon. B. B. Cahoon, of Fredericktown, Mo., writes, Jan. 30, 1879:

"I am much pleased with the Review, and it is well worth the subscription price ($2.50), which I inclose to renew mine."

Boston Scientific Society,
January 31, 1879.

With thanks for kindness in sending your Review to our society and congratulations upon the high standard it has reached, I am,
Ever yours,
J. Ritchie, Jr., Sec'y.

The last number of The Western Review of Science and Industry will compare favorably with similar monthlies issued in the East and making much greater pretensions. Its selections are the best, and in every department is exhibited an editorial ability which does great credit to the publication. This number closes the first volume, and we trust that, in the future, a proper recognition will be extended the publisher in his efforts to establish a first-class magazine.—*Price Current, March* 18, 1878.

The Kansas City Review of Science and Industry. Edited by Theo. S. Case. Price $2.50 per annum. Single copies, 25 cents.

The editor of this popular monthly has for this issue, Sept. 1878, adopted the enterprise of the daily press, in giving at length the proceedings of the American Association for the Advancement of Science—months in advance of any other magazine and of the official record itself.—*K. C. Journal.*

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. II. MARCH, 1879. NO. 12.

PHILOSOPHY.

ABOUT LIFE AND LIFE THEORIES.

BY HON. R. T. VAN HORN, KANSAS CITY, MISSOURI.

The objective of all knowledge and philosophy, of all research and dogma,- of all speculation and theory, is the one problem: Whence are we? He who defines God for us, they who supply gods in pantheons for us, even he who denies all gods or any God, is asking the same question and answering it in his way. It is the one irrepressible inquiry of man in all time, the one mystery that has been plucked at by all humanity. But the secret remains inscrutable as in the beginning. Authority has assumed to answer it, theology has essayed to teach it, revelation has been conjured to authenticate it, and the sword has been invoked to settle it. But the question is still asked. Finally, science has attempted to investigate it, but the oracle has not responded. Over it still hangs the infinite mystery, deepening only as we detect a footprint here and there, and growing in wonder and awe as we approach its ultimate manifestations, or as we draw nearer the portals within which is its habitation.

It is not the purpose of this paper to enter the debate—only to present, as it may, the present state of the question; or, rather, to inquire as to the progress of the discussion, and to note how far investigation is agreed, and to mark the diverging points from the common path.

It would be uncandid, however, were the statement omitted that it is

granted, as a starting-point, that the burden of proof is not on both sides alike. Certainly the original, and, it may be said, the universal inspiration and impulse of humanity are entitled to the affirmative of the question. That affirmative is that life is the result of a creative power or of an intelligent purpose. This is so all-pervading and instinctive as to have been accepted without the processes of reason or the conscious use of that faculty of the mind—and we define it by another word—faith. In fact, we may class it among the moral, as we do the organs of involuntary action among the physical attributes of our being. It is, then, but fair, but reasonable, but philosophic and scientific that this must be set aside, if at all, by the most unanswerable facts.

It may be as well here to state that, so far as authority is concerned, or where a fact of scientific character is stated, it will be from a source recognized by the scientific world and of the latest accessible. And where there is a dispute, both sides will be given. Haeckel, Huxley, Darwin, Tyndall, Beale and others are laid under contribution. But it has been thought best not to cumber the recital by mere repetition of names which add nothing to the force of the argument, but often break the thread of connected statement. The data are all borrowed, and it is only the conclusions or the hypotheses, as the case may be, for which this paper is responsible.

The two theories stand face to face with each other; some call them the spiritual and the material. High authority classes them respectively as religion and science, while hypothesis treats them as creation and evolution. The first idea under all forms of designation demands a power above matter as the cause of life. The second requires, as its indispensable premise, spontaneous generation through the forms and action of matter, the result of which is life. The one requires matter controlled so as to produce the phenomena of life, or vitalized by a supra-material force; the other demands life as from the action of matter obeying its own inherent laws.

This recital, it is hoped, will serve as a fair, if not a scientific definition, and enable us to follow the argument without confusion. It is necessary to fix these radical distinctions in the mind before entering upon the subject, as, when the results of investigation into the ultimate forms of matter and the primitive movements which attend it in connection with the living are considered, the line of separation becomes so involved as to require the constant recognition of this fundamental difference, for both hypotheses deal with the same methods, the same objects, and invoke the same aids. There is but the one road to the same end. The question is not what is the object reached, but how it came there, and by what power it is there?

The hypothesis of evolution demands spontaneous generation as its logical beginning, for its whole theory of development as a law of living things, operating by natural selection and the survival of the fittest, does not even admit of variety or of species, as this at once destroys its consistency. Neither does it admit of an antecedent period, when spontaneous generation was prolific and the different forms of living things were born in the germ, for that would be creation,

and the consequences only growth. And this is all we are asked to believe by the other hypothesis. The fact of life must, then, be found in a beginning from the operation of a law of matter, or from some inhering quality of matter itself. This quality is called force, but that is merely the name given to a supposed potential agent that has not been seen or felt, or even presented to the tangible recognition of the intellect. It is itself a hypothesis.

If this is declined as the basis upon which evolution must rest, there is but one other alternative left—that there was no beginning. And this assumes the immortality of matter itself in the forms in which it is manifest to us. Later on, when we reach the point of speculation, this may be considered, but it has no place here with the two theories under consideration. A theory of which development is the essence cannot take refuge behind a defense which destroys its primal order.

Investigation into the basis of life has been confined in science to the period covered by the microscope, and as its results are uniform in the hands of the observer, be he the believer in one or the other theory, it is only by the light they throw upon the mind, and its point of interpretation, that we reach a conclusion. And it must be admitted that names equally high in authority as investigators differ as to the hypotheses to be drawn from a mutually-admitted state of facts disclosed by the microscope. It is, then, in the careful discrimination of facts and their phenomena, or the looser habit of assuming or of generalization, as distinguished from careful detail, that the weight of evidence is to be determined. For example, the ultimate forms of life must, for purposes of description or explanation, have a name. These are known and spoken of as atoms, molecules, moners, protoplasm, bioplasm—or, specifically, protoplast and bioplast are most commonly used. Protoplast means "first form;" bioplast, "life form;" and in their definition is conveyed the radical difference between the two ideas or theories. It is, then, necessary to be exact in the use of terms, otherwise there is confusion. We cannot in this connection use atom, because it is purely a thing of hypothetical or mathematical existence—it is not microscopic. Molecule is too indefinite for the discussion, as it means only a "little mass." And if we use protoplast, we concede one element of the dispute; and if we use bioplast, we assume a controverted point. It is best, then, to employ the term *matter*, and define its quality by the proper adjective when used, bearing in mind that always when referring to the ultimate forms of matter, as known, it is to microscopic substances.

This ultimate mass, in the hands of Haeckel of the one school, or of Beale of the other, is exactly the same formless, unorganized, colorless particle. It has, however, specific functions, and it is these functions that constitute the point of divergence. According to the school of evolution, the origin of life is the result of combined action of supposed forces inherent in this ultimate mass, and that these forces sustain this result of their combined action. These forces are supposed to be what we call heat, light, electricity, motion, etc. And not only this, but these combined forces enlarge the result by endowing it with indefinite

growth and unlimited variety in development. And still farther, these forces, we are told, are but the modifications of one all-potent and universal force.

We are told, too, in logic, that this force has endowed this result of its combined action with varied properties, by which future spontaneous generation will be rendered unnecessary by investing this primordial germ with the sexual function, from which all life to follow must originate. For the underlying hypothesis of evolution is that this result of the combined action of these forces took place at some inconceivably anterior date, and when the conditions were in fortuitous and incomprehensible conjunction, and that it has been impossible since; that from this remote period we date all life, be it vegetable or animal. This is not overstating the hypothesis—it is not as forcible or as clear as would have been literal quotation.

It must be confessed that this taxes credulity in one direction as far as the dogma of a special and contemporaneous creation does in another. Is it not traveling in the same circle and calling the same things by different names?

This primordial germ of life, we are told, is not hypothetical, but has a locality and a name, and no one need be at a loss where to look for it. It has been discovered in an ooze that is found at the bottom of the sea at great depths. In this ooze has been detected these masses of what this school calls *protoplasm*, or "first forms"—these structureless, colorless masses of matter which have life in them. And because these have been found here, *ergo*, here is the secret of all time wrenched from the eternal keeping of old Ocean by the sounding apparatus of a telegraph cable ship. It is not proper to treat so grâve a topic with levity, nor is it in that spirit that we make the comparison, but, speaking gravely and reverently, where is the essential difference? Moses says: "Man was formed of the dust of the ground." Haeckel says: "Man has come from the ooze of the sea." The one employs material that may or may not have been dry; the other uses that which from necessity must derive all life from that of the waters.

But if this ooze contains the original, primordial, spontaneously-generated life, why does not the act of production proceed with the same force and prolific power as was once its property? Surely this now living ooze was not itself born at the inconceivably remote period that evolution assigns to life, and remained in this primordial state ever since, incapable of growth or development. The same influences that by their withdrawal left life only with the power of extending by procreation, must have killed this form of life if they did not endow it with the energy of increase. It could not have once had the power to grow and be denied it now. This is the very negation of law; and a law of nature can neither die nor be suspended—its essence is its eternity. If we are to accept this, let us not laugh when told that the sun stood still on Gibeon, and that the moon rested in her course over the valley of Ajalon. It cannot have been potential in the past and inert now, and, if born in the recent, it cannot have been primordial. But it furnishes no form of life that can be recognized as traveling any of the intermediate stages of evolution between the first and the last manifestation. It cannot be assigned to the position chosen for it by any known law of growth, or by any

observed phenomena of existing life. If we must accept it, it is because scientific authority on other subjects says that it is what it is. Or, changing the form of expression again, it is "thus says Haeckel," for "thus saith the Lord," "And Haeckel saw the ooze and it was good"—is all the authority we have for it.

True, Sir Wyville Thompson, one of the first discoverers of this ooze, now says he was in error, and that in all his soundings with the *Challenger*, over a period of three years, he failed to find it; yet Haeckel tells us that Emil Bessels, while on the *Polaris*, found it at the bottom of the Northern Seas. So we must admit that, if it does not overspread the bottom of the deep and warm seas of the globe, it is found in the colder seas of this hemisphere. But is it not more rational to accept what other eminent microscopists who have examined this ooze assert that, instead of being a mass of living matter, which grows at the expense of inorganic elements, it is a mass of slime, with many foreign bodies in it, and the debris of living organisms that have passed away, but having numerous living forms still in it?

When, then, we find the advocates of the evolution theory agreed that spontaneous generation is not now possible under existing forms, and find those of equal authority agreeing that this supposed source of life is only a form of existing life, with the one only claimant in favor of it being the primordial state of life, are we not justified in taking the hypothesis as at least not proved, and that we must look for the origin of life in another direction? Is this unreasonable? Is it not demanded?

But what does the physical investigator have for us in this direction? Let us now lay aside hypothesis for awhile and see what the living organism has for the eye. In the lower organisms, in plants as well as the human brain, it is the same and may be studied. Living matter in all living things is in appearance the same—"always transparent, colorless, and without structure." It is the same in the germ in the womb as in the octogenarian the moment before he ceases to live. It never changes its character, never loses its distinctive appearance, never ceases its activity. It has the power of absorbing or taking up other substance and imparting its own quality to it, but is never appropriated by any other substance or changed into it. It has the power of multiplication indefinitely, but only changes its own state by dying. It is born and it dies, but has no development. It forms all known qualities of organic matter, but is without form or consistence itself.

This which will be described as living matter is the agent of all growth. It begins in the germ and pushes itself forward in what we call growth. It moves of its own accord, passing from contact with formed matter, which it takes up and leaves behind it as structure. That it is not pushed by an unseen force in such a case is shown by the fact that in another it pushes — as in the formation of a hair, where the tube is formed at the root and pushed out—the exact reverse of the tissue-forming process. That it is not confined in forming living organism by the process of depositing in one case and pushing in another is shown in its formation of that wonderful thing in the living structure, a nerve, which it spins

as a spider spins its web—that is, it runs ahead at differing distances, drawing out the nerve thread from the mass of material with which it works.

Here we have three actions or functions, and not one of them in obedience to any known law of matter or of the physical world. All are in direct opposition to the law of gravity, neither conforms to any function of chemistry. Not only has it the power to do all these, but it has that to separate and divide itself, and one particle move away from another, or in advance of another, or over or under another, and be performing, so to speak, two or more tasks, or two or more kinds of work at the same time.

We were told in a very interesting paper read at our last meeting in the summer that there was no mystery about this peculiar thing which is called "bioplast," as there was "a muscle, a bone, a skin and a brain bioplast," and so for every part of the living organism. But this is not demonstrable. So far as can be known, there is but the one for not only all structure in the living organism, but for all life. The same inscrutable mass that makes the finger-nail builds up the brain, and the gray matter of that organ is composed of and formed by precisely the same agent that forms the foot. "The living matter of all organisms, and of the tissues and organs of each organism, exhibits precisely the same characters. It lives, and grows, and forms in the same way, although the conditions under which the phenomena of life, growth and formation are carried on differ very much in different kinds of germinal matter." This difference of kind, however, is only known from the fact that some matter will live in states of temperature in which others will die, while matter that will be appropriated by it in some instances will act as a poison in others. While these masses of living matter show no difference in appearance, the only conclusion to be drawn from the fact is that it must be from difference in inherited power. It cannot be from any physical or chemical properties, else we could ascertain it by examination. It is a property that cannot be isolated. We only know that the action in all is the same in every respect. If all matter with life was from this ooze, this difference could not be.

But, then, we are told that all this is from the action of forces, or the inherent force of matter. One of the confusing things in the discussion of exact problems is the improper use of words. And no word is more abused than this one of force. We are told of the force of matter, of the power of matter, and of the properties of matter—all being applied indiscriminately to the same phenomena. There is a wide difference. Power is capable of action, and can do things according to design—can arrange or construct. Property belongs to material things, is passive, and can no more be destroyed than the thing itself. But force may be changed, however, as to form, mode or condition; may assume varied forms and be re-converted into its original one. And all matter might be reduced to chaos again, yet power, property and force exist precisely as now. But in the order of life there is a faculty, which neither force, nor power, nor property can produce or explain, and it will not answer simply to ignore it, or to say it is to be accounted for by some quality not yet discovered. It must be remembered that

"assumption" is the very essence of the objection of the materialist to the system he combats, and if the problem cannot be solved by assumed premises on the one hand, it cannot be overthrown by assumption on the other. We know that living matter displays phenomena and functions which no property of matter from any known process of investigation has been able to explain.

But let us see how this substance that makes all living organism does its work. We shall not follow it from the ovum into the living being, as that is familiar to the student of both theories, and there is no dissent as to the facts. We will see how it works in the processes of growth. First, however, to show the extent of the position held on this subject, let me quote a comprehensive sentence from the concededly highest authority among English-speaking men on evolution. He says: "The whole world, living and non-living, has resulted from the mutual action and non-action of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed." And then follows this sweeping declaration: "It is no less certain that the existing world lay, potentially, in the cosmic vapor, and that a sufficient intelligence could, from a knowledge of the properties of the molecules of that vapor, have predicted, say, the state of the fauna of Britain at this day with as much certainty as we can say what will happen to the vapor of breath in a cold winter day."

How a robust intellect, as is that which uttered this, can after that deny to a "sufficient intelligence" the power, and function and exercise of "foreknowledge," "predestination" and "eternal and unchanging decree" passes understanding. And how it differs from the most unqualified dogmas of theology cannot be detected in essence. It is arriving by a negative at the starting-point o the circle to which the advocates of the other hypothesis arrive by affirmation. It is substituting one kind of creation by another, and, while denying the agency of a personal supernatural power, invests itself with not only the elements of immortality, but with the plan and will of infinite knowledge, power and purpose. But if this is so, and matter has these essential properties, which in proper combinations or conditions must produce life, how comes it that, in all the years of experiment, the combined efforts of the highest skill have failed to produce the smallest, the most rudimentary of living things—have failed to make even a molecule pulsate with life? And is it possible that in the very penetralia of science so broad and sweeping a declaration has no basis but the brilliant imagination of a devotee of demonstrated facts upon which to rest?

But here we come to another assumption, and it is worthy of remark how these champions of "facts" assume so many things which have no known fact to rest upon. While it is admitted that there is no discovered fact to controvert what has been affirmed as to the structureless nature of living matter, and the phenomena of its action, yet we are told this, by another of the most eminent names in science: "That between the microscope limit and the true molecular limit there is room for infinite permutations and combinations." Has it not occurred that if the microscope is to be thrust out of this discussion, the entire system of physical investigation into the origin of life falls with it; or, in other

words, if you must seek a solution outside ascertained fact, the very citadel so long held against dogma must be surrendered? If we let go the inductive system, where is the difference between the assertion of Dean Huxley and Dean Doctrine? If this microscopic mass of living matter disregards all known law of non-living matter, how can it, beyond the microscope limit, be divided into smaller particles that obey that law? Then why this plea from the known to the unknown? How much better is this, from the scientifically-inspired Tyndall, than the story of Genesis: "In the region beyond the microscope limit," he says, "the poles of the atoms are arranged, that tendency is given to their powers, so that when the poles and powers have free action and proper stimulus, in a suitable environment, they determine the first germ, and afterward the complete organism." In all candor and seriousness, is this all that can be substituted, as the basis of human belief concerning the awful problem of life and its results, for that science-rejected story: "And the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and he became a living soul." For the purpose of this argument I am neither affirming nor denying—only contrasting. Each must stand as the plain written record, upon which the acceptors of each must interpret for themselves. I am only quoting for the mind that has presumably formed no opinion.

Let us not refuse to look at truth—or facts, which are the ultimates of truth—but let us beware how we follow imaginings from facts. As an eminent writer on science has tersely and but too truly said: "For many years past the advocates of various physical doctrines of life have been encouraged in every possible way. A large section of the public, it appears, has desired to be taught such views. The statements have been heartily welcomed by the most advanced writers in the periodical literature of our time, who have hailed vague assertions as brilliant discoveries. The merest shadow which appeared to tell in favor of a material hypothesis has been repeated, embellished and forced into notoriety, while researches, in the course of which facts have been discovered favorable to other hypotheses, have been rejected with contempt or ignored."

While this may be taken as strong coloring, but none too much so for one class of people, it has its counterpart in the other extreme, that the advocates of a special creation have too often seized upon a fact that mitigated against the material side and forced it to do duty for every crude dogma which a non-scientific theology assumes to fulminate as an oracle of the unknown. Much of the so-called skepticism of the time is rather a protest against ecclesiasticism in all the affairs of life, not only as to things of faith, but even to the functions of intellectual induction and growth. The intelligent observer of to-day admits that there is less real skepticism among intelligent minds than at any modern period; but, as related to the dogmas of medieval and pre-modern theology, skepticism is almost universal. The deeper men drink at the fountain of knowledge, the more reverential they become, and the higher they exalt the Supreme power in the universe; but they reject that which thunders authority without the lightnings of knowledge, which alone proclaim its authentic mission. If both sides will allow the

growth of knowledge to see God in its own light, and interpret His laws from its own comprehension, without, on one hand, consigning them to the penalties of perdition, or, on the other, banishing them to the outer darkness of scientific ignorance, the churches would be better filled with the people of science and the halls of science more crowded with the disciples of theology than now, and both be benefitted by the thorough cultivation of all sides of humanity and by the sustenance which the hunger of knowledge and faith both would receive.

But, to return. If the advocates of the physical theory of life are to be taken at their word, they must be in possession of facts to justify them in holding it as a belief that the existing phenomena of life are only the result or the consequences of change, that these changes are the result of others, back, link by link, until a time existed when matter was in such fortuitous conditions as, "with suitable environment, to determine the first germ," and from that time to this, through illimitable ages, no such fortuitous conditions have recurred. Not only must they have facts upon which to base such conviction, but they must have what no fact has yet been found to sustain— that these first germs, or this first germ, was itself endowed with the power and functions of illimitable perpetuation and change. As a germ it must have been both infinite in power and immortal in perpetuity; for all science is agreed, all investigation concurs and all experiment consents that there is no form of life known, or possible to be known, that has not obtained its life from a pre-existing and kindred form of life. Here we again return to the starting-point, having traveled to it by the same negative process as before. And what more profoundly supernatural dogma was ever propounded to the human intellect for belief? It is infinitely more shadowy and difficult to grasp than the crudest of the assertions of special creation.

But what is the fact? In all that has been proven, in all that has been seen, there is not a particle of evidence as to the changes which immediately precede the production of anything that is living. That is a mystery beyond all efforts, so far, to tear it from its secret.

We are told that all things are ordered, controlled and upheld by law, but it is a law of which we do not know, while all analogy teaches us that law is from consciousness, intelligence, will and power. If the law is beyond the reading of our methods, the source of the law cannot be explored and its functions made a thing of finite solution. Even admitting that all that is claimed is true, that mere matter was the cause and origin of all life, still the question is unanswered. By what, by whom, from whence, was matter thus endowed with this tremendous power and this creative energy? Creation it is, be it that it was spoken into existence in a moment, or that it wove its myriad mazes of life through illimitable and inconceivable ages. Either way, it is the same mystery; and while the conception of creation amazes us with its transcendent exercise of infinite power, evolution bewilders us by the eternal persistence and the immeasurable profoundness of the divine energy.

But let us go back again to what our eyes see, to what our sense can observe,

in the working of this inscrutable agent that builds up all living organisms, for to our apprehension it is the most wonderful thing in the whole range of scientific observation and fact. The animal organism has been likened to a machine that is made, and runs as it is supplied with force or the fuel to run it. But a machine is made by a machinist, is operated by an attendant, is controlled by a force outside of it that compels it to the performance of its task. A watch has its power from the tension of its spring, and an engine from its fuel, but this power, unlike the watch, has no two ticks alike, nor is it like the engine, for when its fires are out they can never be re-lighted. Nor is this agent of rare appearance, but abundant in every thing that lives, and can be seen and examined by any one who has even an object glass of seven hundred diameters magnifying power. As we are told by an eminent authority, "There is not at any period of life, in health or in disease, a portion of any tissue of a man' body the size of a pin's head, with perhaps the single exception of the teeth of the adult in old age, that does not contain some of this living matter in which purely vital phenomena take place. Nor is there an action characteristic of living beings, at any period of their existence, in which this living matter does not play an all-important part." So we learn that this wonderful agent, by which and from which all life is possible, and through and by which all growth is derived, is not something that is rarely seen or at all mysterious as to existence, but that it is all-pervading and infinite in abundance.

It is not proposed to give a treatise on the manner in which living organisms grow, but it is necessary to describe it as comprehensively as may be done briefly, that the process or phenomena may be understood as bearing on the problem—for we must accept its operations as from law, and in the argument this law must prevail over hypothesis. If theories are not in harmony with it, then they must fail. And law, unvarying, unchangeable, inflexible, is the essence of the doctrines upon which the theory of evolution is based.

These little life-agents we must accept as existing, for research has found them, studied them and demonstrated their work. These little agents or workers were first seemingly one mass. As they multiply in the earlier life they are close to one another. To form organism, they must not only multiply, but separate, and we find they do both. At this early stage it is impossible to tell the functions of any of them, as to which shall spin a nerve, which form a pigment, which construct a vein or artery, or become a blood corpuscle, or what ones shall ultimately build that wonderfully complex machinery of the brain, or descend to the foundation masonry of bone, or the superincumbent structure of muscle and tissue. But they find each its allotted work and do all these things. And when you take the one that forms the gray matter of the brain, and the one that deposits the nails at the ends of the fingers, you cannot detect any difference between them. That there is a difference, their work shows, but it is a difference beyond any terms of science to express. You may say it is molecular change, but, then, what induces the change? If it works by law, what is the law? The

man of faith may guess at it, but surely not the man of science, nor, above all, the advocates of the material theory of life. With these, hypothesis is heresy.

The most remarkable work of these little agents is the nerves, nerve centers and cells. It was at one time thought that these cells were the ultimate forms of life, but it is now known that they are only the reservoirs of nerve force—the cups of the human battery—so to speak, from and to which run the nerve wires of the telegraphic system. The nerves are not in them, but around them. The currents starting from a cell are conducted along many fine fibers, which, by subdivision or branching of the original one, return, as we must conclude, to the place of starting. The assumption that the nerve fiber itself possesses peculiar properties from the material of which it is composed, to account for its action, has no support from observation. So far as we know, a hair might afford an equally conducting medium. They are the cords which transmit the nerve force, and this is all we know. The ganglia, or nerve centers, are now found to be (to carry out the simile) simply relay batteries, by which a supply of force is drawn at distances from the source of impulse, by which the original force acts without diminution of power. Every artery is wound round with this wonderful nerve structure, and thus is the supply of blood, from contraction of the nerves or relaxation, regulated to admit of all emotions.

As we ascend into the brain we see no difference in the character of these little workers; they appear to be in every respect the same, but they increase in number beyond all calculation. In fact, the greater portion of the gray matter consists of these little agents, and the cells and the fibers that surround them in all directions and ramifying among them. Their very multitude is enough to tell us that here is located the supreme office and function of these living particles, and that all below is but the instrument with which it works. What these are we do not know, how they obtain their functions we cannot tell, but what they appear to be we can see. I will, in describing, use other words than my own, that there may be no mistake. "Near the surface of the gray matter of the brain, in the extensive layer above the planes in which the caudate nerve cells are situated, are multitudes of very small bioplasts lying among the finest branches of the nerve fibers. In some places there are aggregations or collections of these bodies. They are nearly spherical, are extremely delicate, and become disintegrated very soon after death. Some sections of the gray matter appear to consist entirely of these bodies, so great is their numbers. Some seem to be connected by very delicate processes of the same transparent material." These masses are situated so as to be capable of influencing and intended to influence the fine nerve fibers that ramify among them, as the slightest change in form or position could not fail to affect the currents traversing these fibers. And we are led with irresistible logic to the conclusion that "these vital movements or vibrations occurring in matter of excessive tenuity constitute, or are the immediate consequences of, mental vital action. The directions in which the living matter is made to move by the conscious life power which directs it will determine the particular cords of the nerve mechanism to be struck. The special movements may be the expression of the

inward ideas. If this be so, mind is the vital power which is associated with this most exalted form of living matter."

Now, this is all we know, and, so far as the power of instruments has been able to aid us, it is the limit of the knowable. And can any one say that the problem is solved? The same question again presents itself: Whence the power which sets in motion to conscious results this wonderful machinery? It has been said that with higher powers this question may be answered. But this is not an answer. Still, there is a partial answer to this, for since this paper was begun an instrument of immensely increased power has been perfected, far in advance of all predecessors, and seemingly beyond what was deemed possible, yet it has no "may be" to give us. It returns the same answer to the questioner—these living particles are the same.

We may, then, stop here, so far as actual knowledge or facts are concerned, as beyond this everything is conjectural or hypothetical. Now, what do these facts teach us as to the cause or origin of life? Do they explain it? No. They only enlarge our perception of the methods by which the force we call life works, and add to our knowledge of phenomena. But it does teach us that, whatever may be the origin, all is under law, as unchangeable as it is wonderful, and as certain in results as it is mysterious in operation.

Now let us go back again to the point of difference between the advocates of special creation by supernatural power, on the one hand, and those of evolution, on the other, with this law in our mind, and its unvarying and universal mode of working. And here let it be said that no one holds in higher esteem and admiration those grand masters in science, nor is there any one whose gratitude goes out to them more abundantly for the illumination they have shed upon the paths of knowledge and in the minds of men. Their devotion, patience and painstaking research, and the wonderful results of their labors to the sum of knowledge, place them among the chief benefactors of mankind, and it would be the presumption of ignorance itself to treat lightly the conclusions to which any of the illustrious company may have felt themselves impelled. But the very freedom they have made possible to the thinker is best improved in weighing these conclusions, and even in dissent their work is more honored than in unthinking and servile acceptance and indiscriminate adulation. They have opened the book of nature to us, and we must read its facts in the same independent spirit that gave it authorship.

This doctrine of evolution, then, must be examined in the light of the facts we have been considering, and in harmony with this law that we know to be at the base of all living organism. We have seen what must be believed to accept the solution of the problem of life, as coming from spontaneous generation. We are equally at a loss as to the antecedent causes producing life from this beginning, as we are to the directing forces and primal inspiration of living phenomena as we see and know them. But we all agree that, whatever they may have been, they no longer exist, and that type and species are permanent, and, so far as our knowing reaches, have been from the happening that produced life itself. There is no change in the law. These living forms of matter have worked in the

same mysterious way ever since life was that they do now. Let us see how one can be and with it the other; or, rather, let us see how impossible it is that both should be.

Haeckel in his work on creation, gives great prominence to the development of the fœtus in various animals and man to show that there is a sameness that he claims as declaring a common origin, or a common descent from the same primordial germ. If we reasoned by the eye alone, his proof would be good. But we know that all germs are formless, and it is the essence of the inquiry how this same appearing and utterly structureless matter comes to grow into so many differing organisms, from the simplest plant structure to the culmination of all forms in man. And it must be said that the hypothesis is all assumed, for we have failed to find a single fact to sustain the conclusion; but, for the sake of argument, let us assume that it is so. Is it not as great a miracle that all this diversity should flow from one germ as that there should be a germ for each? And is it not equally as necessary to have a controlling power for the one as the other?

It seems in the one case possible and reasonable, while in the other it demands a molding agency far more miraculous, and a higher degree of persistent supervision or providence, to have presided over the processes they call differentiation and the adjuncts of environment. Mr. Darwin alone, of the many eminent men who have thought and taught on this subject, has assumed to give us the method or the law, and certainly none has a higher claim, for among the illustrious few no one approaches him in the wide field of research, the patient and minute investigation, and the wonderful accumulation of facts that he has gathered to enrich the intellectual treasures of the world. He has been a loving and a diligent student of nature, and it is not a thing of surprise that, finding so much in her store-house that suggests self-conscious working and a purpose in even her most elementary forms, he should have esteemed her as the origin and sum of her own divinity.

This law of Mr. Darwin, which has been accepted by all his contemporaries who hold to the idea of spontaneous generation, he calls that of natural selection and the survival of the fittest—strongest. The logic of the working of this law is that each new form of life possesses something superior to that which preceded it, and, thus, rising through unknowable cycles, it ultimated in man. It is a beautiful theory, and addresses itself with great and captivating power to the imaginative intellect, and is itself a miracle of ages, in contrast to the other hypothesis, which is a miracle of a given time. The one is a miracle of spoken power; the other of power in persistence.

But, then, it has its unanswered problems. Is this power of persistent and upward change still a property of matter, and are men to become immortal by evolution into angels? If not, what has rendered impossible in the future what has been the law of the past? And if such is the law, how has one type progressed while others stood still? For we do know from the witnesses in the oldest rocks that the same forms of life existed before they were formed that exist on the earth to-day. But it is not the purpose to travel over this much-beaten track

of controversy and argument farther than to say that we have never yet seen these satisfactorily answered. The reply "that it may be discovered" will not do for exact science. We are familiar with supposition and assertion from the other side, because that is the original basis with them. We have to excuse it in theology, for it is its foundation, but we cannot admit the overthrow of one assumption by another. It reminds us, if our theological friends will pardon the digression, of their position toward a troublesome intruder in their own domain. After basing their whole system of faith upon supernatural origin and authority alone, and demonstrating their every proposition and article of creed upon the intercourse between man and the supernatural, they deny that it is any longer possible in this world, and say that there is more knowledge attainable in that way .The two thus arrive at the same point again by diverse paths, and complete the circle from opposite directions. Evolution is the method, but it is no longer operative. Divine interposition and supernatural authority is the warrant of faith, but men can no longer receive light through channels open for thousands of years; neither can object if each is questioned as to its authority for thus delivering the oracles.

But let us come back to the question, and I will evoke only one more illustration as to the impossibilty of accepting this law of natural selection and the survival of the fittest as solving the difficulties that have heretofore attended the theory of spontaneous generation. And, again, I must apologize for the manner in which this illustration is stated, and reaffirm my perfect respect and admiration for the eminent authority it assumes to criticise.

Sometimes the point of an argument or the force of a proposition is made clearer by contrast, and if the manner is colored by levity it often serves emphasis better than grave and dignified postulate. If in what follows there is an apparent violation of correct taste, it will be from the unfortunate method in which the contrast is conveyed, not in the intention which prompts its employment or from want of respect due to eminence in any department of knowledge.

Let us follow the working of the law in the one single instance in which man steps from a lower form of life in obedience to it and appears as we find him. We have seen how these little life-agents work in building up living organisms, and that they follow a law as unvarying as that which controls the stars in their courses. Now, we are told that the two types that come nearest each other are man and the Simian family, or that, if man is the result of evolution, the apes are the nearest of kin—that they are our ancestors. This is one of the strong points of evolution, and without it man cannot be accounted for.

We will take one controlling fact, of undisputed existence by investigation on all sides, and see if we can make it consistent with the theory which Mr. Huxley tells us has finally been demonstrated. It is not that because an Eocene horse had five toes, that therefore man once had a tail, which is the logic of the three American lectures, but we ask that the query presented be demonstrated before we accept the question as closed from the case of the horse.

These little agents build, then, after an unchanging plan, and how do they make an ape or a monkey, and how a man? And, to make it brief, only one part of

their work will be noted, and that upon the portion of the organism in which the radical difference exists between man and all other living things, the place where his patent of nobility is stamped, and where he bears the seal of his power to hold dominion over nature and all other forms of life—the brain. It is a law of development that every type of life grows exactly in the same way, beginning in the same way, growing alike, now this part developed, now this function apparent, and the last, so to speak, finishing touch given at the same points with the exactness of unchanging law.

Now, take the brain of the monkey or ape, and we find that it is the temporal lobe of the brain that is first formed and developed, and the anterior lobe afterward. In man the very reverse of this is the fact. In him it is the frontal lobe that is first built up and most quickly and promptly formed, the lateral or temporal lobe coming last. So we find that in the formative process of the brain of these two families there is a direct opposition, a complete reversal of plan.

Surely this fact requires something more by way of explanation than the mere assertion that, by a" proper stimulus in a suitable environment," this law of growth was set aside, reversed, and a new being the result. But what, according to this theory of natural selection and the survival of the fittest, are we called upon to believe? Only this, that at some inconceivably remote time some powerful anthropoid ape, having selected the most perfect and beautiful of his race for a wife, one fit to wed with princes, and by holding his prize, by virtue of his prowess, against all rivals, became by great pre-eminence the first of his race, thus fulfilling the law. And, now in compliment to this supreme demonstration of physical powers, these little life agents, deeming the last form of ape evolution complete, which had from the first been laying the foundations of the brain in the temporal lobe, suddenly reversed the order, and proceeded to build up at once the frontal lobe of the first-born of this royal pair. Or, they changed a law of life and development that enabled the son and heir to supplant forever the authors of his being—a proof for the eternity of the future of the divinity of this law of the strongest. And who now dare say that, in morals, might does not make right? If we accept the one as the law of life, we must accept the other as the law of morals. The one is only the correlative of the other.

You will see that no favoring condition has been kept back, but we have made the premise as broad as the imagination will warrant. It is in no spirit of levity that the parallel is thus drawn, but because the logic of the theory, as laid down by the Moses of evolution, paints the picture. Taking facts as they exist, and the hypothesis as stated by its author, the result could have come in no other way. Can we, knowing the wonderful and seemingly self-conscious action of these particles of living matter, believe that they must at one time have reversed the law of their work, in deference to any influence arising out of the conditions or environments of any form of life? If we do, then the gods and demi-gods of mythology were as told of them, and fauns and satyrs, Pan and Centaur, but the children of natural selection. The statement of the theory as to what must have been its practical workings, answers it. It is only hypothesis.

And here, perhaps, this paper should close, with the conclusion that there is no physical basis upon which a knowledge of how life came can rest. So far as those who assume to answer for science, there has been no answer. But have research and discovery afforded no clue to a better or more satisfactory understanding of the problem, and are we as far as before from a knowledge of it? I do not think so. But there is this I do believe: as long as we follow the ideal upon which both theology and science have sought an answer—a power working by comprehensive, human methods—the pursuit will be barren of result. There are some things that we do know. We know that life, as we see it, is from a germ, and that the phenomena of life, that we call growth, are from a multiplication of that germ, and that they are susceptible of observation by the senses and may be studied. The vitalizing principle of the germ is what we do not know, and what no science that has been possible, or that we can conceive of, can open to us.

What suggests itself in this direction is stated with the greatest diffidence and with no pride of opinion, but with every apology which should precede mere speculative intrusion. The inverse method is best to arrive at an intelligible idea of the fact of life and its phenomena. Instead of placing ourselves at the imaginary stand-point of the Infinite Power, and then constructing the universe and ourselves for Him, why not reach out from our position and endeavor to grasp that which preceded us?

The religious in us is a fact, and why not reason from this as well as from any fact in physics? It is a fact, the ultimate of a cause. What is the cause? A pre-existent or a superior power of like quality. It finds expression through phenomena resulting from life. It must come from the functions of that form of life which we are. Then there must be a medium for its expression. We can see all the working of this medium, and only fail to see the impulse. We can only comprehend what is not us by what is us. There is a power, a wisdom, a function, a will, greater than we, because the all in us only results in that conception. And we must furnish the explanation. There can be no other method. We cannot obtain knowledge from without as to anything—all knowledge is but our own perception of what is objective. The fact, then, that science is formulated and taught to all minds alike is proof that all mind is from one source, and that source must be the unit of all intelligence. Thus scientific method itself teaches the oneness of all mind and its origin from a common source. Matter, then, being the one universal medium of all phenomena, we must find the "beginning" in the ultimate of matter. And what does this fact of reason lead us to in this direction? That all our sensations come from forms of matter within ourselves, corresponding to the sensation. For example, the eye receives light and expresses it to the mind from the fact that it receives the light upon its peculiar structure, and this structure is but light itself built into this form by those mysterious forms of living matter we have been considering. This illustration will explain the hypothesis advanced. And so of all organism. How can it be otherwise? We can comprehend this, but we cannot conceive it in any other way. And what other process are we capable of outside ourselves?

Have, then, our physical methods been in the right direction? Analogy is the best guide in the interpretation of nature and her laws. Instead of taking matter as dead and subjecting it to blows to separate it — for chemistry, after all, is but force applied to break it into atoms — let us allow it life. There is nothing in the universe that is dead. Matter endowed with life at once becomes the expression of the will that gives it form. It thus becomes instinct with faculty, and must itself possess property function. This presents it to us in a twofold aspect. And can you conceive of anything in nature that has not duality? Why not, then, matter have this principle? If everything in nature formed of matter has it, must not the forming material have it also? To deny it is only to use words. To affirm it is to be supported by everything that we know. This duality may be called body and soul. The body we can know, the soul we must recognize through the only mode of perception given us—reason. The unknown can only be conceived of through the known.

This analogy we find all through nature, and is best illustrated by our conception of the imponderable forces, as electricity, magnetism, etc., when we call it positive and negative. Now, all that is needed is to concede the universe as consisting of matter — not the suns and worlds only, but space as well—and the difficulties rapidly disappear. And why not? We talk of heat and light, and other intangible things, as force. We know they have motion, and is not motion, momentum, impossible without weight? If they have this motion, they have weight; and if they have weight, they are matter. And as they move through or in space, traverse it, space is occupied by or is itself but a form of matter.

The facts of discovery in science all tend in this one direction—the unity of matter. There is no single instance of a real advance in the knowledge of facts that does not support this hypothesis, and in the most recent discoveries demonstration has almost been reached. As at one time the telescope became but the demonstrator of Kepler's theories, so now the spectroscope and the laboratory are fulfilling the predictions for reaching minds, or, as they are too sneeringly called, theories of "scientific imagination." The mind is, after all, being proved to be superior to methods or instruments. And as we have so many proofs by practical investigation of the correctness of hypothesis in this direction, why should we reject the unproved, while the proved are all logically in harmony? We forget they, too, were once rejected.

Take the most recent discoveries as to the sun — all are in harmony. The telescope only told us of magnitude and appearances, but the spectroscope has shown us that this incandescent sphere presents differing conditions as induced by differing states of its matter. We find the mass itself conveying the fact that its matter is akin to that of our own world. Above this that same matter, in a more fluidic state, is the source of that light which it pours unceasingly upon its system of worlds and out into space beyond. And above this, in a still more attenuated form, it bursts into an immeasurable glory of colors. How long since color has taken its place as a potential agent in the universe of life? It is hardly yet admitted to the charmed circle of science. And beyond this, in still more refined

conditions, the unity of all matter is said to have been found. And, lastly, the magnificently suggestive discovery of Crookes of the fourth state of matter, which demonstrates by physical methods the materiality of light. But I must stop somewhere, or this fascinating field will widen beyond all limits of the occasion.

Here, then, is experimental science on the very borderland of the infinite, and the imagination almost reels with expectation as the next step is contemplated—the ultimate analysis of matter. Bearing in mind this dual principle, what must it be? Is it not what we call spirit? And why not? From the lowest forms we can trace this principle up and up, to worlds, to suns, to space, even to the very threshold from whence matter assumes the functions of the living—to where the meeting with its vitalizing principle lies only behind the veil. If we cannot pass into the Holy of Holies, we can bow before the presence of the unknown as it passes to our view, and know that there is no beyond. Here all hypotheses can meet, and there need be no dissension as to the source of all life and all that flows from life. Here matter becomes immortal by association with the principle of immortality, here miracle ceases, and all the required conditions are fulfilled. Here the man of faith, illumined by the light of the ultimate, can worship a God that satisfies the loftiest reach of the most exalted intelligence instructed by the profoundest knowledge, while the man of science can gratify his most exacting demands for a first cause, working only by everlasting and inflexible law. And there is nothing there to disturb the simplest faith of the darkest intelligence. Surely we need not fear to bridge this boundary between the known and the unknown by a scientific faith which so fully satisfies all aspirations and gives to the soul, after its struggle toward the beginning, the solace of requital and repose.

THE RELATION OF SUPERSTITION, OF SKEPTICISM AND OF FAITH TO THE PROGRESS OF SCIENCE.*

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As the topic is broad and the time short, I proceed, without introduction to the definition of terms. By superstition I mean belief without evidence, and even contrary to evidence; by skepticism, the withholding of belief upon good evidence; and by faith, I mean belief on sufficient evidence. Superstition is over-belief, skepticism is under-belief, and faith is reasonable belief.

All these tendencies of the human mind have in turn, exerted a controlling influence upon the development of science, to advance or to retard it, to build it up or to tear it down. Nor are they things of the dead past. They exist and are operative, to-day, as in times gone by.

I. There is scarcely a branch of science which is unaffected by superstition, and surely not the medical science. It has been and still is the bane of medicine.

* Read at the Commencement Exercises of the Kansas City College of Physicians and Surgeons, March 4, 1879.

Go to any drug store and how large a space is given to nostrums, whose virtues are more wonderful than any tincture of ancient fable. Without any great stretch of the imagination you might easily fancy yourself in the laboratory of some weird Alchemist, who had discovered the elixir of life, which was to make old folks young; crooked ones straight, and ugly ones beautiful. The eagerness with which these things are bought by the people is the measure of their superstition, and also the measure of the difficulty with which true science has to contend.

Superstition has always been the irreconcileable enemy of all scientific progress. It has placed itself in direct opposition to every movement which was fitted to check or to bring to an end its own dark reign. It begets a state of mind, which is the most antagonistic to scientific investigation. To pursue science successfully, the mind must be free from all trammels, which would in any way restrain the activity of its powers. Superstition, by the awe and dread which it produces, broods like a nightmare over the mind. How could the Hindoo astronomer investigate eclipses with any kind of success, while the awful dread hung about his soul, that some giant dragon was about to gorge the sun, and to hurl the universe into hopeless ruin? How could the Christian astronomer investigate the properties and laws of comets, with the fear of a general conflagration haunting his mind? What encouragement to endeavors of any kind could there be, so long as men fully believed that their lives and destiny depended on being born under this or that constellation? The belief that every mountain den was peopled with all conceivable goblins and malicious gnomes, who would throw their dreadful spells upon every intruder into their domain, most effectually checked geographical pursuits. Investigators did not penetrate unknown seas, lest they should meet the terrible ghost-ships, huge kraken and the like. The warping and deadening influence of superstition invaded every department of life, and all professions. Incorruptible judges were overborne in their decisions by the belief in witches and sorcerers, and leagues with the devil. They would listen to testimony, telling of old women riding on broomsticks through the air or transforming themselves into wolves and devouring all the flocks of the neighborhood, with the utmost credulity. Upon such evidence they would condemn men and women to the flames, with far less compunction than the modern judge condemns the murderer, upon the clearest evidence of his guilt, to the gallows.

The truth or falsity of the evidence never seems to have entered their minds. All they considered was the amount of evidence. If this was abundant, its truthfulness was never questioned. Chilperic, one of the Kings of the Franks, was assassinated. His heir was only two years old. A brother of the murdered king did not hesitate to cast a doubt upon the legitimacy of the infant Clotair. But the mother, Fredegonda, repaired her somewhat questionable reputation and secured the throne to her son, by appearing at the altar with three bishops and three hundred noblemen, who all swore with her as to the legitimacy of the little prince, and no further doubts were ventured on the delicate subject. The superstitions connected with law and evidence would fill many quartos.

There have been periods when the names physician and magician were used

synonymously. Doctors were looked upon as dealers in the dark art, which was to a very great extent true. Superstition settled down like an incubus upon the minds of men. How could the medical profession go into an investigation of the laws of the human constitution so long as the belief held sway over their minds that some magical hocus-pocus would be more availing than all science?

It is wonderful how the greatest minds, which have done the most to emancipate science, should still remain under the power of some prevailing superstition. The great Kepler, who gave astronomy such a start forward, could never free himself from the shackles of astrology. The clear vision of Francis Bacon was often dammed and perverted by gross superstitions.

After the restoration of Charles II, a superstitious reverence for the divine right of kings prevailed among certain classes in England. The King sent to the Royal Society, which was composed of the leading scientific men of the realm, for them to explain how it is, that when a *live* fish is thrown into a basin of water, the basin, water and fish do not weigh more than the basin and water before the fish was thrown in; whereas, when a dead fish is employed, the weight of the whole is exactly equal to the added weights of the basin, water and fish. Much learned discussion followed, several elaborate papers were read, and many theories were propounded. At last some one suggested that the experiment be made. This brought down a storm of abuse upon his head. To doubt was considered an insult to his majesty and tantamount to an act of constructive treason. The experiment, however, was made, and to the confusion of the wise men of Gotham, it was found that the weight was exactly the same, whether a dead or a live fish were used. The superstitious reverence for royalty overbore their common sense.

Again superstition, by the introduction of the supernatural into all the phenomena of nature and life, took away the motive to scientific investigation and research. If everything be done immediately by the finger of God, there is no room for reason, nor for research into the causes of things, which is the true work of science. God does it and that is all that can be said. Whenever such a belief prevails, the efforts of men will be to find some means of influencing Deity, rather than searching into the causes of things. Superstition will soon invent ways and means. Talismanic words will be more effective than the profoundest knowledge of things. Where now would be the motive to the study of medicine, if all men believed that the mutterings of some old witch over a kettle of boiling herbs would communicate to them greater healing power than the best compounds which science and skill can produce? Suppose the belief was universa that the elixir of some quack had greater virtue than man was to find in the prescriptions of the whole medical profession. Who would study medicine? Against this form of superstition physicians have had to contend in all the past, and to-day it is one of the greatest hindrances in the way of success. It is astonishing how few people follow the advice of their doctor implicitly. The most mingle some superstitious notions with his directions. On this account very often, the greatest ignorance will be preferred to the greatest skill, simply because

ignorance will cater to superstition and science will not. If some trifling thing is to supersede intelligence, knowledge and skill, it is only the few that love science for its own sake will ever pursue it. Superstition, by taking away the motive to endeavor, produces a complete stagnation in every department of life. Italicus, a Christian horse-racer was beaten repeatedly on the course, by the pagan Duamvir of Gaza. Instead of trying to improve his stock by breeding and training, Italicus made application to St. Hilarion for help. He told the Saint that it never would do to let the heathen beat the Christian at the horse race—it would certainly bring disgrace upon Christianity. At his earnest solicitation Hilarion furnished him with some holy water with which he sprinkled his horses just before starting in the race; and now they shot like arrows by all competitors, leaving them far behind. Against such jockeying there was no redress.

It is not only in this indirect way that superstition has hindered the progress of science, but it has offered positive resistance. It has resorted to all possible means to check and bring to an end scientific investigation. When the philosophers undertook to prove the existence of the antipodes, Cosmas entered the strife, and tried to show from Scripture that they were an impossibility. He tried to stab a scientific principle with a text. He said St. Paul taught that all men were made to live on the *face* of the earth, therefore it followed, that they could not live on the *back* of the earth. This seems to me to be the most contemptible and impious use to which science can be put. Cosmas then tells us what he considers to be the orthodox form of the earth. "It is a flat parallelogram with high mountains on all sides to which the sky is glued." What a glue that must have been! He was only the first of a long line of ecclesiastics who ignorantly tried to crush the first risings of science with a load of scriptural texts.

Superstition was not contented with seeking to argue down and to frown down science, but its great effort has been to force it down. It has instituted laws against it; it has kindled the fires of persecution and resorted to every unfair means to banish it from the earth. This is the relation of superstition to science.

II. What is the relation of Skepticism to science? It has done a good work in the suppression of superstition, and in clearing away its practically evil consequences; but in combatting superstition it has gone to the opposite extreme of denial and negation, which is well nigh as fatal to scientific progress as the evil which it swept away, for if superstition believes too much, skepticism believes too little. It has gendered a narrow-minded dogmatism, which refuses to accept anything that cannot be submitted to sensuous tests and experiments, and in this way virtually plays into the hands of superstition; for science becomes a poor shrunken thing when you take from it all that cannot be demonstrated and submitted to the senses. We talk, indeed, of gravitation, caloric, electricity and magnetism as if we knew what they are; yet these are but expressions of our ignorance, fence-words, which show that we have reached the outermost limits of our knowledge. We observe certain phenomena and we refer them to a supposed cause which we name the force of gravity. This causal power has never

been observed, but only thought. We know there is something, but what it is we do not know. Another class of phenomena passes before us; we bind them up into a sheaf and label them electricity. Why this new name? Have we found a new power? Have we gone behind phenomena and discovered a new cause? Not at all. We have observed two distinct classes of effects, and we refer them to two supposed causes; these causes are believed — not seen nor known. The same is true in regard to all the forces of nature. Science, without forces, would be nothing more than a barren collection of facts. Skepticism, to be consistent, should deny the existence of forces, for they cannot be seen nor demonstrated. What they are we know not. If you can show me force, I can show you God. Skepticism has developed a system of doubt, which denies everything which lies without the narrow circle of its experience. In this respect it has proved itself to be one of the great hindrances to scientific progress. It has begotten a race of doubters whose only achievement has been negation. A few illustrations from the history of science will show the truth of this assertion.

The Phœnician sailors in the service of Pharaoh Necho, King of Egypt, reported that they had circumnavigated Africa. The skeptics of that day ridiculed them for the very statement which to us is the greatest confirmation that they made the journey, namely, that mariners declared that during part of the time the sun rose and set upon their right—that is, in the northern half of the heavens, as with us in this latitude his course is through the southern half of the heavens. The Venetian doubters nick-named their famous traveler, Marco Polo, Mr. Million, because he reported cities in China with several million inhabitants. Late researches in China and her coasts have shown the truthfulness and exactness of this traveler's reports. Our own day has witnessed the same narrow skepticism. The discoveries of Livingston, of Krapf and of Speke were all disputed and pronounced impossible by learned geographers. When these discoverers announced the vast lake Victoria Nianza, in equatorial Africa, the idea was ridiculed until it was confirmed by later travelers. When the German missionaries made known to the learned world a mountain in Central Africa covered with perpetual snow, they were laughed at. It was said that no such mountain could exist in that region. The skeptics claimed that the missionaries mistook dazzling quartz or chalk for snow. But later discoverers have ascended the mountain and found snow enough. Copernicus, the father of the present system of astronomy, experienced far more opposition from the skeptics of his day than from the church. His great work on the heliocentric theory was dedicated to the Pope; and Cardinal Schomberg was his special patron. The Newtonian system of gravitation was opposed by the great philosophers of the last part of the seventeenth century and the beginning of the eighteenth. It had to fight its way against persistent skepticism. That it was possible for stones to fall from the sky was looked at skeptically by the wise academy of Paris. To them, showers of stones were as absurd as showers of frogs.

Nor has the medical profession been free from this narrow-minded skepticism. Those great men who have made epochs in the science have had to con-

tend against great and prolonged skeptical opposition. Harvey spent eight years in research and investigation before he made known his views in regard to the circulation of the blood. He repeated and verified his experiments over and over again. He published his thoughts on this great subject in a modest tract; the language and style were simple, perspicuous and conclusive, but it was received with jeers and ridicule on all sides. He was called a crack-brained fool. For some time he did not make a single convert, and the little practice that he had dwindled to almost nothing. He seemed to be without a friend. Skepticism and superstition joined hands in their *generous* work of destruction. He was denounced as seeking to subvert the authority of the Scripture, and to undermine the foundations of modesty and religion.

The difficulties which Jenner had to meet in making known one of the most beneficent discoveries ever known to science were even greater than those of Harvey. He heard one of the Glostershire milk-maids say: "I cannot take the small-pox, for I have had the cow-pox." This riveted his attention and he set about making experiments. When he mentioned to his friends his views of the prophylactic virtues of the cow pox, they laughed at him and threatened to expel him from their society if he harassed them any longer with his absurdities. He went to London and was so fortunate as to be under the celebrated John Hunter. He communicated his views to that great anatomist whose charge to him was: "Don't think, but try; be patient, be accurate." He returned home and continued his investigations. After twenty years he published them to the world. He gave twenty three cases of successful vaccination of individuals, to whom it was impossible to communicate small-pox by contagion or inoculation. This all went for nothing. The discovery was at first received with indifference and afterward with positive hostility. He went up to London to exhibit to the profession the process and successful results. He found all ears closed against his demonstrations. After waiting in the city for nearly three months, not a single physician could be induced to make a trial of his discovery. He was caricatured for his "attempt to bestialize the species by introducing into their systems the matter from a diseased cow." Here again superstition joined with skepticism. Vaccination was denounced from the pulpit. It was declared "that vaccinated children become ox-faced; that abscesses broke out to indicate the sprouting horns; that the countenance was gradually transformed into the visage of a cow, and the voice into bellowings of bulls," and yet the great Cuvier says of Jenner's discovery: "If vaccine were the only discovery of the epoch, it would serve to render it forever illustrious."

This register of willful skepticism might be extended indefinitely — a register that nearly corresponds with every valuable discovery in science, which has almost universally been disparaged by an obstinate skepticism. The stand-point of scientific skepticism is illustrated by that of the African prince, who threw a European into prison as an impostor because he told that in his country water became hard, like a stone, and that men and wagons traveled upon it as upon a highway. The negro had never seen water in any other than a fluid condition.

This was an unvarying fact withithin the limited circle of his experience, and yet he had generalized it into a universal law of nature. With the same narrowness, skepticism generalizes its one-sided empiricism into a universal law.

From all this we learn that skepticism is but the opposite side of superstition; that both have their origin in a narrow dogmatism which will tolerate nothing beyond its limited circle, and thus both become the antagonists to scientific progress.

III. What is the relation of Faith to the progress of science? I have defined faith as belief on sufficient evidence. The scientist observes certain phenomena of weight; upon experiment he finds that they are always the same under like circumstances. He necessarily refers them to some cause; that cause cannot be observed or known. Faith apprehends it and calls it gravity, and reason formulates its action into the law of gravitation. The sciences of astronomy and mechanics are proofs that this faith is well grounded.

Again, certain other uniform phenomena pass before the man of science; experiment reveals that their uniformity is not casual, but a law. By the necessities of his own mind he is compelled to refer them to some cause. No observation, no experiment, can reveal the cause. But Faith seizes it and he calls it electricity. The telegraph, the telephone and the electric light are the evidence that his faith is well founded. Other phenomena are referred to magnetism as their cause; others, to vital force; others, to nerve force. But none of these forces are objects of knowledge; they are believed. Without faith it is as impossible to be a scientific man as to be a religious man. Had Sir Isaac Newton doubted, as John Stuart Mill did, whether or no two and two might not equal five upon some far-off star, he never could have made the greatest scientific discovery that ever was made. Newton believed that mathematics were the same on the sun, on Jupiter, Neptune and the farthest star as upon our earth. His calculations were based on this belief, and the results show that his faith was built on a sure foundation.

Not only is faith the starting-point of science, but it has been the great factor in every onward movement. Between the beginning and end of every undertaking is a vast gulf which reason cannot see across, but faith links both ends together. Between sowing and reaping there is always a wide chasm which only faith can bridge. By faith the farmer sows; by faith the man of science launches out upon the unknown sea in search of truth; he knows not what is before him, yet faith enables him to press forward, 'mid surf and foam, toward the desired haven.

Almost every advance in science begins with hypothesis. Men are unable to explain certain facts; they suppose an explanation—that is, form an hypothesis. The formation of every hypothesis is faith. The scientist believes that such a theory will interpret such and such facts, and in this belief goes to work to test the truth of his hypothesis. Copernicus believed that the facts of the solar system could better be explained upon the supposition that the sun was the centér of the system, than upon the old Ptolemaic hypothesis that the earth was the center. In this faith he went to work and mathematically proved the truth of

his hypothesis. He first believed, and afterward knew. Had he not at first seized the truth by faith, he could not have elaborated it by reason. Newton first believed in the law of gravitation, and then, by long and toilsome years of thought and calculation, he established it upon the incontrovertible basis of fact and reason. His was not a blind faith; it was a faith on sufficient proof.

One of the sublimest examples of faith is Columbus. He believed in the new world long before his eyes rested upon it. His faith threw a bridge across the Atlantic and in spirit landed him on the golden shores of America. With heroic patience he went from sovereign to sovereign of Europe, entreating them to accept from him the new world. When at last he was started for his prize, what was it that sustained him amid the perils of an adventurous navigation; amid cries of a mutinous crew, in whose angry eyes he saw his own death written? It was faith. By faith he lives and asks only for three days, the last of which presents to him the sight of the long hoped for land. There was nothing blind in this faith. He had accepted the truth that the earth is a sphere, and was confident that if he sailed westward he must strike land somewhere. This was the buttress upon which his faith was built.

Faith has been the distinguishing feature of those great men in the past, who have created epochs in their respective sciences. The true pioneers and promoters of science and of all departments of knowledge have invariably been men of faith. Without faith Copernicus, Kepler and Newton would never have made their discoveries in the material heavens; nor Linnæus, Cuvier and Agassiz in zoology; nor Lavoisier, Liebig and Faraday in chemistry. Faith has been the guiding star of all those elevated characters and noble spirits who have led their race onward.

Faith is the twin-sister of reason. Faith is winged, and flies on before, seizes the truth and holds it, until reason, with slow and labored step, comes up and identifies and proves it. By their union both become vigorous and beautiful, and science, art, philosophy and religion all move forward. By their severance faith dwindles into sickly superstition and reason into a barren skepticism, and all departments of truth wither as if the sirocco's blast had passed over them.

PALEONTOLOGY.

THE DINOSAURS OF THE ROCKY MOUNTAINS.

PROF. A. LAKES. COLORADO SCHOOL OF MINES.

From time to time we hear of discoveries of remains of gigantic monsters in our mountains. Some of these have been rather tall stories, founded on a certain amount of fact with an uncertain amount of imagination. Having ourselves

discovered several of these monsters, and having been in their close society for some weeks at Yale, we would offer to your readers some account of what is known of these huge forefathers of the race according to Prof. Marsh and the best authorities.

Many thousands, perhaps millions, of years a ago a long, tropical arm of the sea extended from the Gulf of Mexico over our western plains and Rocky Mountains, before the Rockies had attained their present height.

There were islands in those seas covered with semi-tropical firs and small palmettos, willows and other trees, and these islands were marshy in places. Along these marshes walked some of the most gigantic forms the world has ever seen. Monarchs of sea and land, these were the Dinosaurs or truly terrible lizards, and their remains are traceable for many hundreds of miles in a narrow belt of rock along the base of the Rocky Mountains. These creatures, which in their anatomy are intermediate between running birds, like the ostrich, and reptiles, such as crocodiles, were, for the most part, of enormous size; some from seventy to eighty feet in length and of great bulk; others were no larger than a cat. These were, for the most part, herbivorous in their habits. The skin of these animals was sometimes naked, sometimes furnished with an outside skeleton of bony shields like alligators, which they more resembled than most living animals. Some of their vertebræ had a hollow cavity looking toward the tail; hence they are called opisthocœlons, or hollow behind. The trunk ribs of the upper portion of the body were double-headed. The teeth were confined to jaws and implanted in distinct sockets. There were two pairs of limbs armed with claws, and in some cases the fore limbs were small in proportion to the hind limbs. The astragalus bone of the feet much resembles that of a bird. The Dinosaurs belong to what is called the Mesozoic period, the great age of reptiles, and when the chalk of England was forming at the bottom of the sea and over many parts of the old and new world, reptiles of the most extraordinary as well as gigantic forms were inhabiting both sea and land. Such were the igaunodons, megalosaurus, cetrosaurus and others. The iguanodon was a huge reptile twenty-five to thirty feet long, so called because its crenated teeth resembled those of the little modern iguana. It was herbivorous, and that it stood high may be judged from a thigh-bone five feet long, with a circumference of twenty-two inches. From the small size of its fore limbs, and occurrence of the tracks of pairs of gigantic three-toed footsteps left upon the rocks, it is indicated that it sometimes walked on its hind limbs like birds.

A still greater monster called the Cetrosaurus, found in Europe, was from forty to fifty feet long. It stood ten feet in height, acccording to Prof. Philips and was unmatched in size and strength by inhabitants of sea and land. As to whether it lived in sea or on land is a little doubtful, owing to some of its bones being found in marine, others in estuary and others in river accumulations. The structure of its limbs for walking implies that it took a "constitutional" at any rate, when so disposed, on "terra firma." The projection of the head of the femur in the acetabulum claims a free step. The large claws also imply land habits. It

may, however, have been amphibious, and the vertical height of the upper portion of the tail implies this. So we have a marsh loving animal dwelling amongst ferus, Cycads and Conifers, full of insects and small mammals. From its teeth it appears to have been herbivorous like the iguana.

The Meglosarus is another oolitic reptile from twenty to thirty feet long with tibia and femur each three feet, giving a leg of six or seven feet in length. The position of the head of the femur, at right angles with the shaft and long bones containing medullary cavities, implies that its habits were also terrestrial and carnivorous, as shown by its trenchant teeth, which are conical, compressed and with serrated edges. The fore limbs are very much smaller than the hind limbs there is no exoskeleton or outside skeleton. To these worthies we might add the Compsognathus of Sohlenhofer, which is more like a bird than the other Dinosaurs.

In true Dinosaurs the neck was short, the femur longer than the tibia and very much like a bird. The head of Compsognathus was furnished with hooked jaws, supported on a long slender neck; the fore limbs short and out of proportion to the hind limbs, and also like a bird in structure. The same relationship is noted in the tarsus, or ankle joint of the foot, which was united to the tibia, whilst again, in other respects it was unlike birds. Huxley considers that some of these creatures hopped like birds, in an erect position, to which class of beings, especially, the Compsognathus with its long neck, slight head, hollow bones and small fore limbs gives an extraordinary resemblance.

We now come to the description of our own domestic monsters which inhabit the Rocky Mountains.

On the flanks of the mountains is a narrow belt of strata, traceable for hundreds of miles, and marked here and there by bones of these gigantic Dinosaurs. Its position is above the Trias and below the hard sandstones of the Dacotah, which, by the way, contain many leaves of an extraordinary character, being the first Dicotyledons that are known upon this planet. By Dr. Hayden this belt was supposed to be cretaceous in age, but the abundant vertebrate remains discovered by Capt. H. C. Beckwith and myself, Prof. Mudge, and also by Mr. Lucas, at Cañon City, and by Mr. Williston, of Prof. Marsh's party, in Wyoming, prove, according to Prof. Marsh, its Jurassic age, and in honor of one of the largest monsters characteristic of these beds, he has called them the Atlantosaurus beds. The strata is estuary, being deposits of shale and sandstone, and seems to correspond to the Wealden, of Europe. Besides the Dinosaurs, remarkable crocodiles, tortoises and fishes, a pterodactyl and a mammal were discovered. These differ somewhat from the true Dinosaurs. The Atlantosaurus immanis, of Morrison, was at least 80 feet in length, and others equalled it in bulk. But with these terrible great lizards, there were also some scarcely terrible little lizards—the Nanosaurs, no larger than a cat. These Dinosaurs resembled somewhat the crocodiles of the Mesozoic period. We may give some of their most striking characteristics. The fore limbs and hind limbs of the Atlantosaurs were nearly equal in size, so there is no particular reason for their aping the bird by walking on their hind feet, that we know of. The carpal and tarsal bones were distinct. The

feet were plantigrade, and had five toes. The precaudal vertebræ contain large cavities, as it were bored in them, supposed to assist in lightening the great weight of the vertebræ and, being filled with air, are called pneumatic cavities The neural arches are united to the centre by suture. The sacral vertebræ, a number of vertebræ generally united to form a strong attachment for the tail, consist of not more than four in number, each having its transverse process.

There was a relative of his, called Diplodocus, 50 feet long, and another, Laosaurus, not 10 feet long. There was a monster, however, at Morrison, some hundreds of miles from where the former were found, called Apatosaurus ajax, one of the vertebræ of whose colossal neck was 3½ feet in width, and implies a neck full 5 feet wide. The getting out of this last monster, through the snows of winter, was attended with no little peril to the party. A ledge of rock some hundreds of tons in weight, under which the scientists had been digging, giving way with a crash during the night. Had it fallen in the day time, bones historic would have been added to those primeval. But even these great herbivorous lizards were not without their foes. There were the Allosauridæ, carnivorous dinosaurs, averaging from 20 to 25 feet in length, their feet armed with sharp claws. One of these was called Creosaurus, flesh eater, a cannibal among his kind.

Whilst the Atlantosaurs were a distinct family, they belonged to a sub-order called sauropoda, or lizard-footed. A very perfect skeleton of one of these found by Mr. Williston, in Wyoming, may be taken as typical. Its head was small, showing by the fixed quadrate bone of the jaw and other features a resemblance to crocodiles. The rami of the lower jaw were not united by symphysis. The teeth were numerous, the neck was long, and the vertebræ had deep cavities in them, to lighten them, as in birds of flight. These vertebræ were hollow behind. The humerus bone was massive, and its ends roughened and covered with cartilage. The toes were thick, and had strong, hoof-like claws. This animal, when alive, was full 40 feet long, and walked on all-fours. Its movements were probably sluggish, and it does not seem to have suffered from too deep meditation, as its brain cavity was extraordinarily small—smaller than any known vertebrate not one-tenth of its size.

We next come to a huge reptile, also of Morrison, whose remains are embedded in so hard a matrix of rock, that Prof. O. C. Marsh, who was at work at them for weeks after the party in the field had blasted them in more senses than one, called out a parody on his name in the lines:

> "Break! break! break! at thy cold, grey stones, O. C!
> And I would that my tongue could utter the thoughts that arise in me," etc.

This monster was a nondescript, part dinosaur, part plesiosaur, and part turtle, at least he seemed related to them all. The teeth have compressed crowns and are inserted in sockets. Others of a cylindrical character, more probably spines of the back-bone, are placed in rows of imperfect bone or cartilage. The vertebræ are biconcave. The limb bones indicate an aquatic life. The long body was protected by large, bony plates, like the great turtle Atlantochelys, supported by long spines of the vertebræ. One of these plates was 3 feet long. It

was about 30 feet long, and moved by swimming. It was the mailed warrior of the lakes and ponds.

Such were some of the monsters which enjoyed themselves in olden times around the Rocky Mountains, then islets just peeping above an inland sea. In the marshes and bayous of these islets the Atlantosaurus and other Dinosaurs enjoyed life, sometimes plunging in for a bath, at other times walking boldly on the land and cropping the leaves from the primeval forests. All their friends and foes were reptilian; even the birds were half reptiles and armed with teeth, and the mammals, such as they were, were also allied to the reptiles. All the reptiles laid eggs—and what an egg must Mrs. Atlantosaurus have laid! She is supposed to have been 100 feet long, and, judging from her huge thigh-bone, 9 feet long probably, standing erect, 18 to 25 feet. Truly the Roc's egg, found by Sinbad, must have been the only approximation to it. The climate was warm and uniform, as attested by the fauna and flora of a warm tropical sea, which occupied the western prairies and plains from the Gulf of Mexico over the Wahsatch range. The period closed by a bodily upheaval of the whole western half of the continent, by which the cretaceous sea was drained off, and this, no doubt, caused the death of many of those monsters, though most of them probably died like other creatues, or were mired in the mud which now entombs them in the form of sandstone, uplifted by mountain upheaval, like angry waves surging toward the shore; but, unpoetically known in those regions by the name of *Hogbacks.*

GEOGRAPHICAL NOTES.

THE NORDENSKJÖLD EXPEDITION.

Mr. Nicolas Latkin, who accompanied Nordenskjöld as far as the Lena, has addressed an interesting communication on the expedition to the St. Petersburg *Gazette:* He doubts the veracity of the report that Nordenskjöld has been debarred by the ice near the East Cape from continuing the voyage, because, according to his experience, an open sea generally exists there up to the middle or even the end of November. Should he, nevertheless, have been frozen in on the entrance to Behring's Strait, attempts at reaching him ought to be made from Nischir-Kolymsk or Anardyrsk.

If Nordenskjöld, as is not improbable, has been wrecked at the new Siberian Islands, where he contemplated anchoring for a few days, it would not be difficult to find him, particularly as hunters from Ustjansk or ivory merchants settled at the mouth of the Tudigirka annually visit this archipelago, as well as Tadijeff and the Kotelny Islands, in order to collect the teeth and bones of the antediluvian mammoth. Mr. Latkin affirms that some of the hunters even remain on

those islands the whole year through. Reconnoitering parties could thus be easily organized, especially in winter. The best time for such expeditions, of which those under Mr Sanikoff, a merchant, and Mr. Hedenström, a distinguished scholar, have made themselves famous in the beginning of this century, is the months of February and March, and also the first part of April.

In case Nordensjöld passed the New Siberian Archipelago and wintered on the Wrangel Islands, it will certainly be more difficult but not impossible to establish a communication with him. The Wrangel Islands are, according to the latest Russian maps, situated about three hundred versts to the north of Cape Schilaskoi and two hundred versts from Cape Jakan. A sledge expedition, such as has often been already undertaken and even on a greater scale than now necessary, could be dispatched for the Wrangel Islands if a few hardy, enterprising men were to join it. The most practical time for such an excursion has certainly already passed, but attempts might nevertheless still be made. Mr. Latkin estimates the expenses of a sledge party, either to the New Siberian Archipelago or the Wrangel Islands, at only about twenty thousand rubles. We entirely agree with Mr. Latkin's remarks that, even if such expeditions for the discovery of Nordenksjöld should fail in effect, a small tribute of gratitude for the wondrous achievements of the heroic explorer would at any rate have been accorded him.

A telegraph report from Baron Fredericks, the Governor-General of Eastern Siberia, to the Russian Minister of the Interior, in which he gives an account of his endeavor to assist Nordenksjöld in his supposed distress, was received. The dispatch, dated Irkutsk, the 13th (25th) of January, reads as follows:

"On hearing that the *Vega*, with Nordenskjöld and his party, was reported to be frozen up near the East cape, I instructed the Governor of Yakutsk, on the 2d of January, to dispatch from Nishni Kolymsk, or some other suitable place, experienced Tunguses, with reindeer sledges, for the help of the daring Swedish navigator, and at the same time to propagate as fast as possible among the native tribes the intelligence of Nordenskjöld's perilous position. I also ordered him to threaten the severest punishment for any offense or cruelty committed against the needy explorers. The Governor of Frimos likewise received instructions from me to send Tunguses to the Anadyr Bay, and thence to advance on the ice as far as they could. Afraid lest these sledge expeditions, owing to the lateness of the season and the great difficulties to be encountered, might not be in time to give the desired aid, I telegraphically inquired on the 8th of January at the Admiralty whether it would not be advisable to dispatch, on the commencement of spring, one of the vessels stationed at Wladiwostock or belonging to the squadron in the Pacific Ocean, to the Behring Straits in order to search for the *Vega* and rescue her party, who, in all probability, will have abandoned her and forced their way to one of the Tchoutchouk settlements."

Capt. S. R. Franklin, U. S. Navy, in charge of the Hydrographic office at Washington, D. C., has published, for the use of the Navy department, an account of the Nordenskjöld expedition, accompanied by a chart showing the

alterations in the Siberian coast line rendered necessary by Nordenskjöld's surveys. The following extract is of interest in connection with the commercial advantages that are expected by the opening of trade with Siberia:

"78.—Late publications regarding the expedition entertain sanguine expectations of important results in a a commercial way; it is even stated that commerce with the interior of Siberia might thus be opened with the western shores of the United States. A calm review of the narrative of Prof. Nordenskjöld would seem to show that prospects for this are not very encouraging. A comparison of the narrative with the experience of explorers of the Nova Zembla and Kara seas in previous years will make it evident that the *Vega* happened to hit an extraordinarily favorable year. The trade from Northern Europe to the mouths of the Obi and Jenisei may be profitable enough for ventures, but even on that short route it will require the pilotage of the sturdy Norwegian fishermen and seal-hunters, who are acquainted with the ice of these seas during all stages of the short season. A vessel going to the Lena either way would have to be fully provided for the emergency of being embayed for the winter in the Arctic. If, notwithstanding all this, ventures should be entertained, the following notes may prove of interest and value:

The distance from San Francisco to the Lena is, in round numbers, 3,500 miles, of which 1,000 miles may be considered ice navigation—the distance from the mouth of the Lena to Jakutsk, the first place of commercial importance, is about 850 miles. The river is navigable the entire distance and much farther; but, owing to shallows, only for vessels of light draught; cargoes would, therefore, have to be transferred at or not far from the mouth of the Lena.

At Jakutsk the river forms a basin, almost four miles in width, studded with numerous islands.

Entire Siberia has a population of 3,440,000 (0.70 to the square mile), Eastern Siberia, 1,514,758; the province of Jeniseisk, 396,783 (0 39 to the square mile); Jakutsk, 236,067 (0.16 to the square mile); and that of Irkutsk, 358,629 (1.16 to the square mile). The town of Jakutsk, with 4,830 inhabitants (1873), has extensive trade as the depot for Eastern Siberia, and is the seat of one of the factories of the Russian American Company. According to Von Humboldt (*Kosmos*, Vol. IV), it is probably the oldest town on the globe. The Shergin mine near it shows that the ground is frozen to a depth of 300 feet, thawing in midsummer only three feet. The mean temperature for the year is 13.7° F.; in August the thermometer rises for about ten days to 85°, but from November to February it remains between 42° and 68° below zero. The Lena is frozen for nine months in the year.

Irkutsk, about 1,000 miles SW. of Jakutsk, at the confluence of the Irkut and the Angara, near the sources of the Lena, about forty miles from the Great Baikal sea, is, next to Tobolsk, the most important town of Siberia, and the seat of government of Eastern Siberia. It has 32,320 inhabitants (May, 1875), and is the principal depot in Siberia for the Chinese caravan-trade; it has several fine educational institutions, one of them a military academy and navigation school,

an important cloth manufactory, and extensive distilleries. There is great wealth in the larger Siberian towns, and the wealthier classes and the higher Russian officials live in great luxury, which would seem to render trade profitable.

Articles of export to Siberia would be grain, manufactured articles, and colonial products such as sugar, spices, etc.; there might, however, be a sufficient supply of grain from Southwestern Siberia, which is mild and fertile. Articles of import to the United States would be principally mineral ores (graphite) and furs, as also teeth of the ante-diluvian mammoth (fossil ivory), which have been excavated in surprising quantities from the frozen banks of Lena.

P. S.—Since the above was written, it has been stated in some of the newspapers that two sledge expeditions, sent by the Governor of Eastern Siberia for the relief of the *Vega*, could not find a trace of her near the reported position, and that the Russian authorities surmised her to be embayed between the New Siberian Islands, where the channels among the latter and between the southernmost and the mainland are not much over thirty or forty miles wide, and therefore easily blocked by pack-ice.

79.—The westernmost positions reached by vessels from the eastward are: That of U. S. S. *Vincennes*, of U. S. North Pacific Exploring Expedition, under command of Lieutenant, now Rear-Admiral, John Rodgers, U. S. Navy, August 19, 1855, longitude 176° 50′ E., where her progress was barred by packed ice, and that of the whale-ship *Nile*, Long, master, August 11, 1867, longitude 170° 30′ E., where that vessel was also stopped by the ice.

The *Vincennes* made the above longitude in one day from Behring's Strait, but was fourteen days working back against adverse winds."

THE OXUS RETURNED TO ITS BED.

Mr. Edward Campury, in *Le Devoir*, a Guise weekly paper, says that the late news of the changing of the bed of the Amoo is of very great importance to Russia, and he believes that the phenomenon, far from being accidental, has been effected by Russian enterprise.

The Amoo river is the ancient Oxus over which Alexander the Great led his army into Afghanistan, and which at that time emptied into the Caspian Sea, but which, for some two hundred years, has emptied into the Sea of Aral—a lake, properly, for it is about the size of Lake Huron.

Any one who looks at the map of Asia will see that there is no river flowing into the Caspian on the east except a little stream in Northern Persia, and that the great Amoo River receives all the drain of an immense watershed in Western Turkestan.

The Arab writer Mokadassi says that the Amoo once flowed into the Caspian Sea, and that it was displaced by a king of Khiva, who dug a canal to lead some of its waters through the plain of Kharezem into the Aral Sea; that the river

preferring that canal abandoned its own bed from that time. The Khivan dikes turning the river out of its own bed near Kounich-Ougendi are well known to engineers, also the old bed of the river Oxus, which is even indicated on most maps.

Mr. Champury says: "To-day, either by an accident that Russia should thank its stars for, or more likely through a most skillful Russian maneuver, the Amoo has broken the Khivan dikes and taken possession of its ancient bed. The enormous mass of its water now flows toward the Caspian, thus increasing the length of the river more than 500 kilometers" (310 miles). Peter the Great, according to the same writer, dreamed of turning this river back into its ancient bed, and commissioned Prince Bekowich in 1717 to study the measures necessary to effect that result. More recently, and at different times, the abandoned bed has been surveyed by Russian officers. It is, therefore, reasonable to suppose that the late rupture of the Khivan dikes is not merely accidental, especially when we reflect upon its significance to Russia and to the development of civilization in Central Asia. Steam navigation will be possible on the new river, and, if not, the Russians will not long delay in making it so, in order that the rich territory lately annexed from Turkestan may communicate with the Caspian Sea. From this to gaining a navigable opening into the Black Sea, either by the Koor River, in the southern valley of the Caucasus, which river extends about nine-tenths of the way, or not far from 300 miles, or by the way of the Volga and the Don, there is but a step. The Volga, which flows into the northwestern part of the Caspian, almost touches the Don about 200 miles from the mouth of the former—that is to say, thirty or forty miles of canal, and the long-sought Russian port on the Black Sea is a thing accomplished.

The British Association have sanctioned a scheme for the dispatch of an expedition to study the natural history of the island of Socotra. The most important of the vegetable productions of the island appear to be the Socotrine aloes (the finest in the world), the dragon's blood gum and date palm. The terrestrial fauna appears scanty, but the sea swarms with fish, while amber, ambergris and pearls have been exported, and fisheries of the latter are still worked.

The ship "True Love," of Hull, was broken up last year after more than ninety years of active service within the arctic seas.

The possibility of water communication between the Obi and Yenisei seems to be confirmed by late explorers. Baron Aminoff, after having explored the divide between these rivers, reports that the necessary hydraulic works for the construction of a canal with sluices would not present serious difficulties. The canal would be very short, and the marshes at the sources of the Kas and Yazevaya rivers afford a sufficient amount of water.

Two new expeditions to Central Asia are planned in Russia for this spring. The first, by Col. Prjvalsky to Hlassa, in Thibet, and thence to Afghanistan; and the other by M. Blumenfeld, a German savant, who has studied in Russia for botanical and geological explorations.

On January 25th the Geographical Society of Paris held a public reception in the large hall of the Sarbonne, in honor of MM. de Brazza and Ballay, the two French Ogoevi explorers. The great medal for 1879 was delivered on this occasion by Admiral La Ronciére, le Noury, president of the society.

Some members wished this medal given to Nordenskjöld, but the prolongation of his voyage, owing to his detention in Behring's Straits, was considered sufficient reason to postpone his claim until 1880.

Count Wilczek and Lieutenant Weyprecht intend to visit the coast of Nova Zembla in the course of the present year, and will remain there for a year or more, in order to make a series of exact magnetic, electric, hydrographical and meteorological observations. The cost of the expedition will be defrayed by Count Wilczek himself.

The November number of the *Bulletin* of the French Geographical Society contains Dr. Jules Crevaux's account of his exploration in the interior of French Guiana in 1877. Dr. Crevaux, with little assistance, in the face of not a few difficulties, ascended the river Maroni, and, striking the river Yary, traced its course to its junction with the Amazon. The two main results of his journey are the crossing for the first time of the Tumuc-Humac chain at the level of the sources of the Maroni, and the discovery and complete delineation of the Yary, an important affluent of the Amazon. The Maroni he describes as a fine river, of about 140 leagues in length, with a breadth of 1,200 to 1,500 meters at twenty leagues above its mouth, and from 400 to 500 at ninety leagues. The river Yary, Dr. Crevaux considers as more important than the Maroni; it is 150 leagues long, and both rivers are much obstructed by falls and cataracts. Dr. Crevaux gives some very useful notes on the forests of Guiana and the different species of trees which they contain. The highest summits of the Tumuc-Humac range do not exceed 400 meters above sea-level. In summing up his observations on the geology of the region traversed, he says that all the formations met with, from the mouth of the Maroni to that of the Yary, have an ancient physiognomy. They are mainly composed of schistose rocks, which may be divided into three systems, which are in the order of age: 1, the gneiss of the mouth of the Maroni; 2, the schists and mica-schists of the middle course of the river; 3, the ferruginous schists and quartzites of the Maro-Bari and the Yary. These latter are very widespread. All these are frequently traversed by granites and trachytes.

The last number of the *Isvestia* of the Russian Geographical Society contains an interesting paper by Mr. Grigorieff on the temperature and density of water in the Arctic Ocean, along the coast of Russian Lapland and in the White Sea, being the result of observations carefully made on board the schooner Samoyao, by means of good instruments. As to the Arctic Ocean, Mr. Grigorieff confirms the existence of a warm branch of the Gulf Stream which flows along the coast as far as Gavrilovskeize Islands, and thence turns due east to the Kanin Peninsular and Kolgueff Island, and, further, to the Moller Bay on Novaya Zemlya. Beneath this warm current there is a cold one flowing in an opposite direction at some depth. When it meets with a rising bottom; especially with the deep banks of less than 100 fathoms under 71° north latitude, this denser and cold current is compelled to change its direction and make its way between the Gulf Stream and the shore; hence the low temperature and great density of water at the Lapland coast, in the space between Svyatoey Nos and the Seven Islands. The density of the eastern (North Cape) branch of the Gulf Stream (1.025 to 1.026, figures which correspond to a percentage of salt of from 3.28 to 3.41) seems to be smaller than that of the Spitzbergen branch, where Nordenskjöld has found a percentage of salt as high as 3.625. As to the White Sea, Mr. Grigorieff denies the entrance of a branch of the Gulf Stream into that sea, as was supposed some years ago by Prof. Middendorff; the Gulf Stream does not penetrate further than the Gulf of Mezen, and the warm temperatures observed by Middendorff are due to purely local causes. On the contrary, a cold, polar current enters the White Sea along the Tersky coast, whilst the current which flows out of the sea into the ocean, follows the Winter and Kanin coasts. The water of the White Sea, on the whole, has a very low temperature, especially in the deeper parts; on depths more than 100 fathoms the temperature is always below 32° Fahr., and this because of the great loss of heat during the long winter. Altogether, the observations, having been made and computed very carefully, and published *in extenso* in the *Isvestia*, are a real acquisition to science.

THE SUEZ CANAL.

Mr. Farman, United States consul-general at Cairo, Egypt, furnishes the Department of State with an interesting article on the Suez Canal. His facts are derived from authentic sources. A few of them are selected of remarkable interest. The entire cost of the canal was 472,921,799 francs, or $92,273,907. The stock of the company consists of 400,000 shares, at 500 francs each. These shares have sold as low as 100 francs each. At the opening of the canal they had advanced to only 300 francs. They are now quoted at 717 francs, and are probably worth more. The British government paid about 568 francs. The number of shares bought, in 1875, by Lord Beaconsfield at this price was 176,602. This great purchase, aside from its political and commercial advantages, thus affords a clear profit of 25,000,000 francs at present prices. The balance of the stock is held by a large number of persons, mostly in France. The revenues of the canal

have increased from 5,000,000 francs in 1870 to over 30,000,000 francs in 1877. The expenses, including interest, sinking fund and lands, have been a little over 17,000,000 francs per year. While the revenues steadily increase, the expenses are decreasing or stationary. Deducting the amount paid for interest and the sinking fund, the actual expenses are about 5,000,000 francs annually. The cost of cleaning the canal and its accessories is only about 2,000,000 francs per annum. The small comparative cost of maintaining the canal arises from the fact that there are no locks or lateral embankments to be broken. Except the ordinary cleaning, there is little to be done. Vessels drawing twenty-five feet of water or less pass through the canal. The saving of distance to the British ships going to India is nearly 5,000 miles. Two-thirds of all the vessels passing through the canal carry the English flag.

Monsieur Ferdinand Lesseps, who has been at the head of the enterprise since its beginning in 1854, expresses the opinion that the Panama canal must be constructed without locks to be successful or remunerative.

AFRICAN EXPLORATIONS.

Mr. Cuthbert B. Jones, United States consul at Tripoli, in his dispatch to the Department of State, dated January 22, 1879, announces that on December 27, 1878, Dr. Roehfs, accompanied by Dr. Stecker and Baron Coillagh, left Tripoli to explore a portion of Africa hitherto unknown to the world, the southern part of the Stadai country. Dr. Roehfs, when in Tripoli in 1866, contracted the Mussulman belief. He is now a Christian, which may somewhat embarrass his enterprise. He is one of the most successful African explorers, having made several difficult voyages into the interior.

NOTES ON POLAR EXPLORATION.

BY CAPT. H. W. HOWGATE, U. S. A.

The following notes, collated from a recent English work, show the feeling abroad upon the subject of Polar Exploration as contemplated in the bill now before Congress to authorize and equip an expedition to the arctic seas.

The United States has naturally, from its geographical position, a greater interest in the solution of the polar problem than any other nation, and reasons sufficiently strong to induce the British Government to fit out a costly expedition should have weight with our own in considering the proposition to send out a comparatively inexpensive one, that promises valuable practical as well as scientific results.

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The complete exploration of the unknown area surrounding the Pole must be achieved by a Government expedition, because thorough preparation and equipment are essential, and because, in the case of large bodies of men passing

through an arctic winter, naval discipline and *esprit de corps* are absolutely necessary. The enterprise, though feasible and devoid of undue risks, is one of vast proportions

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There is an abundance of excellent animal food up Smith Sound; the climate is exceptionally healthy, and, though the officers and men will be exposed to individual dangers and privations which will test their high qualities to the utmost, there is no more chance of a disaster to the whole expedition, and far less danger of sickness, than on any other station frequented by the ships of our navy.

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No work can be conceived more important to science, more useful to our navy, and more worthy of being undertaken by our Government.

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"*He is not worthy to live at all who, for fear and danger of death, shunneth his country's service and his own honor, since death is inevitable, and the fame of virtue immortal.*"—SIR HUMPHREY GILBERT.

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"The navy," said Admiral Sherard Osborne, in 1865, "needs some action to wake it up from the sloth of routine, and save it from the canker of prolonged peace. It cries not for mere war to gratify its desire for honorable employment or fame. There are other achievements as glorious as a victorious battle; and a wise ruler and a wise people will be careful to satisfy a craving which is the life-blood of a profession."

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One of the most distinguished medical officers who has served in the arctic regions (Dr. J. J. L. Donnet, Deputy Inspector of Hospitals and Fleets in the British Service) is convinced that, of all seas visited by men-of-war, the Arctic have proved the most healthy. In every sea casualties will occur, but in the Arctic those which have been noted during the last quarter of a century have been few and far between, and they have risen chiefly from frost-bites, from which one death alone is recorded. Of those diseases which swell the bills of mortality in England, especially of that class termed zymotic, which includes typhus, typhoid, small-pox, etc., none are recorded.

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If the solution of the greatest geographical problem that remains to be solved, and the attainment of numerous important scientific results, are not considered worth the expenditure of the trifling sum required, an expenditure which will be richly and abundantly repaid, the character of the English-speaking people must have strangely altered with the present generation. No such extent of unknown area as that which surrounds the North Pole ever failed to yield results of practical as well as of purely scientific value; and it may be safely urged that, as the area certainly exists, its examination cannot fail to add largely to the sum of human knowledge.

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Professor Newton, of Cambridge, has drawn attention to some interesting

questions relating to the migrations of birds toward the unknown area. He says: "The shores of the British Islands, and of many other countries in the northern hemisphere, are annually, for a longer or shorter period, frequented by a countless multitude of birds which, there is every reason to believe, resort in summer to very high northern latitudes for purposes the most important, and, since they continue the practice year after year, they must find the migration conducive to their advantage. There must be some water that is not always frozen; secondly, there must be some land on which they may set their feet; and, thirdly, there must be plenty of food, supplied either by the water or by land, or both, for their nourishment and that of their progeny.

"People who have been in Iceland and Greenland have noted the appearance of these birds in those countries, but in neither of them do they stay longer than with us; and, as we know that it takes no other direction, it must move farther north. We may, therefore, fairly infer that the lands visited by these birds in the middle of summer are less sterile than Iceland and Greenland, or they would hardly pass over those countries. The supply of food must depend chiefly upon the climate. The inference necessarily is that beyond the northern tracts already explored there is a region which enjoys in summer a climate more genial than they possess."

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The unknown results of exploration must have due weight. Judging from analogy, we may be sure that many of the discoveries of the polar explorers will be unforeseen and unexpected. The learned president of the American Geographical Society, in June, 1871, well said that we do not know and cannot estimate in anticipation the consequences that will result from more accurate knowledge of our globe, and that Columbus found very few who would sympathise with him or who perceived the utility of the effort on his part to go out into the unknown waste of waters beyond the Straits of Gibraltar in search of a new country. Who can at this time estimate the advantages which have followed upon that adventure? If now it should be possible to reach the Pole, and to make accurate observation at that point, from the relation which the earth bears to the sun and to the whole stellar universe, the most useful results are very likely to follow in a more thorough knowledge of our own globe.

Referring to the bill (H. R. 447) to authorize and equip an expedition to the arctic aeas, I have the honor to submit that, aside from any benefits that may accrue to science from a thorough exploration of the vast area within the Arctic circle yet unknown to civilized man, the present reduced condition of the whaling interests of our country would alone justify the expenditure of ten times the cost of the proposed colony on the shore of Lady Franklin's Bay as a reasonable effort to discover and develop new whaling-grounds.

It may be that there is no large body of water—no "open Polar Sea"—within this unknown area, but it is the opinion of some of the most distinguished geographers and experienced explorers that one does exist, and that it abounds in such forms of life as are found in more southern waters.

Prof. Maury, the distinguished scientist, says "within this Polar area *the whales have their nursery.*" Prof. Agassiz, another distinguished scientist, of whom New England is justly proud, writing to the president of the American Geographical Society in favor of a polar expedition then before the public, says: "I consider it as highly important, not only in a scientific point of view, but *particularly so for the interests of the whale fisheries. The discovery of a passage into the open water around the Pole, which would render whale fishing possible, would be one of the most important results for the improvement of whale fishing.*"

The following figures, taken from Mr. Starbuck's exhaustive history of the whale fisheries of the United States, show the startling decadence of this important branch of national industry and the necessity of prompt action to prevent its total extinction:

In 1846 there belonged to the various ports of the United States 647 ships and barks, 35 brigs and 22 schooners, with an aggregate capacity of 233,189 tons.

On the 1st of January, 1877, the entire fleet was reduced to 112 ships and barks, and 51 brigs and schooners, having a total capacity of 37,828 tons.

The value of bone and oil brought into the United States in 1854 amounted to $10,802,594.20, and in 1876 to only $2,639,463,31.

While I believe that the interests of geographical and scientific discovery as set forth by Profs. Henry, Loomis, and others, in connection with the proposed Arctic Colony, are of themselves of sufficient magnitude to warrant favorable legislation, the additional practical and commercial results that are possible would seem to demand such legislation as a matter of justice to that section of the country whose inhabitants depend so largely for their employment upon our whale fisheries as those of the New England states.

The following statement in reference to the cost of the proposed Polar Colony on the shores of Lady Franklin Bay, as provided for in Senate bill 438 and House bill 447, respectively, is respectfully submitted for consideration:

1. *The Vessel.*—This is to be used simply to transport the colonists and their supplies from the United States to their destination, returning as soon as this is accomplished. Any small vessel now in commission will answer this purpose, and need not be occupied more than three months in the year at the most.

The vessel, with her officers and crew, being already in service and maintained by stated appropriations, the only additional expense required for the purpose would be that incurred in strengthening it foi service in the ice. This cost would probably not exceed $5,000, as my small vessel, the "Florence," which passed the winter of 1877–8 in the arctic, was strengthened for one-tenth of this sum.

The Colonists.—The colonists are to be detailed from men now in the army and navy, and would receive the same pay and allowances as when on duty elsewhere.

There would be no increase in the present number of men in either service, and no additional cost to the United States beyond that of the few articles of pro-

vision and clothing especially required for arctic work. These provisions would probably cost for the three years $17,500, and the clothing $2,500 more, or $20,000 in all. There is now ready for the use of the expedition a large quantity of fur clothing, collected by the "Florence" expedition of last year.

The Scientific Corps.—The members of the scientific corps, like the colonists, would be detailed from the several arms of the service, and, in like manner, would entail no more expense to the United States than when on duty elsewhere. Astronomers, meteorologists, naturalists, physicians and specialists in the most important branches of science, are to be found in the service of the Government, who would willingly volunteer for the duty, and could be temporarily spared from their present labors without detriment to the United States.

The balance of the appropriation asked would be required for the purchase of special instruments and apparatus, of buildings for the shelter of the colonists, for balloons and sledge outfits, etc., and would be ample for a three years' supply.

The Florence, a small sailing vessel, fresh from a winter in the arctic, and completely fitted for another voyage, will be placed at the disposal of the expedition as a tender, without charge to the United States.

The various items of cost have been gone over carefully by men of experience in the kind of work proposed, and their accuracy verified by comparison with former expeditions and by my own recent personal experience.

If the bill passes as drawn, I have no hesitation in saying that the sum appropriated will be sufficient to carry out the purpose of the expedition in a manner that will reflect credit, not only upon the men personally engaged it, but upon the nation, to which foreign nations are now looking for a solution of the polar mystery.

PHYSICS AND METEOROLOGY.

PROBABLE CAUSES OF ARCTIC HEAT IN FORMER TIMES.

BY EX.

A theory to account for the former high temperatures that existed in the Northern Temperate and Arctic regions. On the necessarily different conditions that existed in the diurnal phenomena; the relation between latitude and temperature, etc., etc.

PROP. 1. The development of vast coal formations after the silurian period was undoubtedly caused by the deposit in place of an enormous aggregate of vegetable growth, fostered by circumstances and by conditions not now existing, and a development of terrestrial temperature now unknown in high latitudes.

2. That we may have good reason to believe that at the period when the coal-fields of the devonian and carboniferous periods, and down to the tertiary

age even, were formed, abnormal causes contributed to produce a peculiar rapidity and profusion of growth now unknown; that this was mainly due to excessive conditions of heat and moisture, aided, perhaps, by an excess of carbon, also seems generally reasonable and satisfactory, but yet does not account for the higher temperature that existed from the 37° north latitude to, well into the Arctic regions, for a period, we may say, to the end of the miocene period.

3. That all that is claimed for, or in explanation of, the vast accumulation of coal formed in the carboniferous age can as justly be claimed for the coal formations of the cretaceous and tertiary periods in the New World, which, in area, even exceed all the so-called "true coal measures" of Europe, Asia and America combined.

4. That, to account to-day for the high temperature that once prevailed even as far north as the Melville Islands in the Arctic regions, we believe the following hypothesis might explain what has hitherto been an unexplained problem, which hypothesis we propose to develop and consider. And we will here say that we firmly believe that the anomalies of latitude, temperature and the seasons, now prevalent from the equator to the pole, did not then exist in the devonian, the carboniferous and to the end of the cretaceous and tertiary ages; and, using Dr. Candolle's terms, the growth of "megathermous" and "mesothermous" vegetation in those geological periods was caused by a totally different condition of temperature and the seasons.

5. That at a period of time (we might say the devonian age) we may suppose that the motion of the earth in space was the same as now, with the sun as the central point of the solar system, but that a source of attraction then existed, situated in the vast stellar space outside of the earth's orbit around the sun and at an immense distance from the earth, this attraction being powerful enough to arrest or modify the motion of the earth on its axis.

6. That in the earth's yearly revolution around the sun this source of attraction kept the earth's longest axis (that of the equatorial ellipse) constantly parallel to this line of attraction in stellar space.

7. That, as a consequence of this modified or destroyed axial motion of the earth, the alternations of day and night, and of the seasons, and consequently the diurnal temperatures of the long days and long nights, were totally different from present conditions.

8. That, as a consequence of the lengthened period of time that the heat and light of the sun were continued in high latitudes at either pole, the long twilight, the prodigiously longer days at either pole, the long periods of moonlight, joined to excessive evaporation of water from the large areas of seas and lakes that then exceeded our present water surfaces, must have been singularly favorable for tree and plant growth, and made the flora of high latitudes profuse and almost unlimited in their season. We would thus easily conceive that the Arctic Continent could readily support a growth of trees of magnificent foliage and size. We can even think, with the present knowledge we have, that in the carboniferous age the anomalies of temperature and the different seasons, the whole "*tout*

ensemble" of diurnal phemomena, were then at their maximum; that in the cretaceous age they were already much modified, for between these two radical periods of geological successions we find very conclusive and precise indications of a successive adaptation of the organic world to strongly modified conditions of the earth's surface.

9. That this condition of the earth was not in the carboniferous period favorable to the existence of terrestrial vertebrates, or birds and insects, but eminently fitted for saurians, fishes and mollusca, and that generally, from the knowledge we have of the animal life that existed, no very serious or wide-spread changes in animal creation took place within the cretaceous period.

10. That while these conditions previously enumerated prevailed, the influences of heat, cold, light, air, water, wind, tides, and all meteorological phenomena generally, were much modified; sub-aerial denudations and the dynamical effects of the elements were different in amount and results.

Geologists have been for over 100 years working on the intricate problems of their science, approximated for the successive ages and periods from the archæan up to the post tertiary, the relative areas of water and dry land that existed in the several periods. If we collate these with the assumption of a globe at first without axial motion, or our present diurnal change, and then this motion successively modified and increased until the tertiary period, we think many geognostic problems might be solved. If we take the tide, for example, whose effect is continuous, irresistible and ever-active, yet we know its power must finally very materially affect the earth's motion, retarding it slowly year by year. Certainly we may not be able to say now how much precisely it does do so for the short period known of human science, yet, as it had once a beginning, so must it necessarily end, or be much modified when the earth's axial motion is finally arrested by it, and the attractive and repelling forces altered by this changed motion.

11. That the hypothesis of a former change in the length of our present day, which is measured by one rotation of the earth on its axis, in no manner disagrees with the Mosaic account of creation. For if we cannot agree upon the occult meaning of his chronology in precise years of time, from the day-dawn of earth, yet this in no manner attacks the truth of his testimony if we can geologically define the period that elapsed before the six days of creation.

12. That the variation of the motion of the earth in the ecliptic, its varying inclination, the eccentricity of its orbit, the effect of the precession of the equinoxes, and the changes which every 12,900 and 25,800 years, as it has been claimed by some scientists, take place from the above causes—changing alternately in the northern and southern hemispheres the length of summer and winter—cannot in amount be great enough to account for the former high temperatures existing in the Artic regions from the carboniferous to the miocene, tertiary period. If we to-day count our summer from the March solstice to the September solstice, we have 186 days of sun for the northern hemisphere, against 179 days for the southern hemisphere, thus making the southern hemisphere a little colder. But it has been shown that, taking the very highest estimate possible, the difference of

seasons that all the above variations of the position of the earth can take would cause a difference of season between the two hemispheres not exceeding thirty-six days in all, and would alternately affect both in the same ratio. This certainly could not be sufficient to transform Greenland and the Melville Islands into a climate like that of Florida or Louisiana to-day.

13. The vegetation of the carboniferous age was rank, dense and peculiar; probably agreeing with De Candolle's mesothermous type; requiring at least a mean temperature of 66°. This, with abundant moisture, frequent rains, long days and warm nights, would give us the most favorable conditions for the growth of calamites, sigillarias, lepidodendrons, floras and equisetaceæ so abundant in the carboniferous period.

14. Following this period, and until we reach the cretaceous period, we find but a scanty list of plants and trees in the permian, triassic and jurassic; the area of water on this globe was largely in excess of land surface. In the cretaceous we find this proportion has decreased some, and that in the Dakota Group, so well elaborated by Prof. Lesquereux in his flora of that group, we find the ancestors of our present forests of oaks, plane trees, magnolias, cedars, yews, sassafras, laurel, poplars, sweet-gums, etc., that indicate a growth of trees peculiar to our temperate latitudes south of 38° north latitude, indicating generally a temperature of an isotherm of about 60°.

15. That this order of climatic and terrestrial changes extended until late in the tertiary period. We might state it, perhaps, as lasting until the end of the miocene, which in Greenland to-day shows a fossil vegetation rich in oaks, cedars, magnolias, palms, figs, etc. That after this period the revolutions of the earth on its axis increased rapidly, the seasons, the length of day and night became more and more pronounced and shortened, cold invaded the more temperate circumpolar lands, the vegetation of high latitudes then either perished or slowly retrograded south and north from their respective polar regions toward the equator.

CONNECTION BETWEEN THE DAILY FLUCTUATIONS OF THE BAROMETER AND OF THE MAGNETIC NEEDLE.*

BY PROF. JOHN D. PARKER.

At a recent meeting of the Academy of Science, Prof. J. M. Greenwood asked the following question: "Is there any connection between the daily maxima and minima of the barometer, and the diurnal fluctuations of the magnetic needle?" Let us consider this question in the light of general principles.

First, what causes the daily maxima and minima of the barometer? It is a familiar truth that a column of mercury, at the level of the sea, about thirty inches in height, weighs the same as a column of air of the same base extending to the top of the atmosphere. In an atmosphere *in equilibrio* in temperature, all

*Abstract of a paper presented at the February meeting of the Kansas City Academy of Science.

its columns from base to extreme surface would be of the same height and weight. If a column of air be heated it will expand and flow over the neighboring columns, or lose its weight; but if a column be cooled it will contract, and the neighboring columns will flow into it and increase its weight. If the barometer falls in a country it is because the temperature of that country is higher than that of neighboring countries, whether heated directly, or those regions have cooled. If the barometer should rise in a country it proves that this country has become colder than those regions that surround it. As a region becomes heated, we should expect that the barometer would fall there and *vice versa.* Rain, according to these principles, is only an effect produced by the conditions of the atmosphere which the barometer detects. When a region of the earth is heated, the weight of the atmosphere becomes less, and the vapors gradually settle toward the earth, and are precipitated in rain.

In accordance with these principles a maximum of the barometer should occur at midsummer, while two opposite daily crises should occur at the hours of greatest heat and greatest cold. Observation proves a general correspondence with these laws with some anomalies. The atmosphere proper contains a small amount of vapor which may be termed the vaporous atmosphere. The increase of the solar heat due to the season, or hour of day, augments the amount and weight of this vaporous atmosphere. Its relation to the barometer is, therefore, inverse of that of the atmosphere proper, or the permanently elastic fluid. Out of this contradiction all the anomalies spring. If we separate these two atmospheres, and note simply the effects of the permanently elastic envelope, we find the heights of the barometer are inverse the heights of the thermometer.

Combine these two atmospheres and we have three barometric curves, only two of which need now be considered. From the maximum height of midwinter the pressure diminishes until the vernal equinox, because the dry air expands, diminishing its weight, without a corresponding increase in the amount of vapor. From the vernal equinox the pressure increases during the summer months, because the rapidly increasing vapor more than compensates for the diminution of the weight of the dry air. From the autumnal equinox the total pressure diminishes, the aqueous atmosphere precipitates rapidly, while the weight of the dry air augments slowly, after which the barometric curve ascends gradually until the barometer attains its winter or absolute maximum.

We are prepared now, in the light of these general principles, to understand the daily maxima and minima of the barometer, or the diurnal curve. Take out the effect of the vaporous atmosphere, and we reduce the barometer to a single diurnal curve — a maximum at the hour of greatest cold, and minimum at the hour of greatest heat. Combine the two atmospheres, and we have two maxima and two minima, in general as follows:

Minimum of morning,	3 hours and 45 minutes a. m.	
Maximum	"	9 hours and 37 minutes a. m.
Minimum of evening,	4 hours and 5 minutes p. m.	
Maximum	"	10 hours and 11 minutes p. m.

During winter these hours are nearer midday by a difference, sometimes of nearly two hours. The diurnal curve, of course, is greatest at the equator where we find the most vapor, and diminishes toward the poles. We find, therefore, that the daily maxima and minima of the barometer is due to the solar heat operating upon the two atmospheres that constitute the total envelope of the earth.

Secondly, let us consider if the daily fluctuations of the magnetic needle can be traced to the same general cause. We can see this part of our subject also better in the light of general principles. A steel bar magnetized, and freely suspended from its center of gravity, does not coincide with the geographical meridian, but deviates by an angle termed magnetic declination. The line along which the needle lies is called the magnetic meridian. The needle has also a tendency to dip as we approach the magnetic poles. The illustrious Humboldt induced the Russian and British governments to establish magnetic observatories in various places, so that maps (like these charts) of the magnetic meridians have been constructed.

Now, if you take a wire and pass a current of electricity through it, you find the magnetic needle will, when brought near it, take a position at right angles to the wire. It has been found that the solar heat induces currents of electricity in the earth which pass around it from east to west. The immense quantity of vapor abstracted from the ocean in the equatorial regions also conveys electricity with it toward both poles, which is discharged more copiously at certain seasons, causing the Aurora Borealis and the Aurora Australis. These currents, in returning toward the equator, probably combine with the currents of electricity passing around the earth from east to west, and cause the needle to deviate, destroying the coincidence of the geographical and magnetic meridians.

We are now better prepared to understand the daily fluctuations of the magnetic needle. The pole of the needle least distant from the sun makes a double diurnal excursion. It is at its western maximum from four to five hours before the sun crosses the meridian of the place, then moves eastward reaching its eastern limit one or two hours after the sun passes the meridian, and repeats this variation, within less extended limits, as the sun passes the inferior meridian.

Thus we see that the daily maxima and minima of the barometer occur at nearly the same hours as the diurnal fluctuations of the needle. The daily excursions of the needle are doubtless due to the variations induced in the electrical currents by the increase of the solar heat, which, also operating through the two atmospheres composing the total envelope of the earth, causes diurnal fluctuations of the barometer. Both fluctuations are probably due to the same cause, the solar heat, which, however, operates in different ways and through different media. This is sometimes termed the thermo-electrical theory, and may be accepted until a better one is discovered.

Prof. Greenwood asked the author of the paper, if he thought heat produced electricity. Prof. Parker replied that heat does not produce electricity as an acorn produces an oak; but a disturbance of the thermal conditions produces a disturbance of the electrical conditions. As illustrations of this principle, a lamp

will cause a current of electricity to flow along a wire, and a very hot day is sometimes followed by a thunder-shower, or more often by what is known as heat-lightning.

CORRESPONDENCE.

RECENT FACTS FROM COLORADO.

BY J. K. HALLOWELL.

EDITOR KANSAS CITY REVIEW OF SCIENCE:

Dear Sir—Under the present excitement of the public mind regarding this State, and especially the portion drained by the head-waters of the Arkansas river, anything written for publication should be as near to known facts as possible, with most of the hearsay left out; as, on carefully "panning" the latter, it will not always show "color." But "where there is so much smoke there must be some fire," and, thinking as much, I concluded to come and see for myself, to learn the country practically, and, if possible, to also give what I might learn as facts in as plain and simple a manner as possible to those who might be interested enough to read.

The first effort that I made was the attempt to divest my mind of all preconceived notions of the country, and particularly of the idea that Leadville was the only place to go to, especially under the present excitement that is working in that direction, as it cannot help but be a fact that the future profits of the coming immigration have already been largely discounted at that particular place. If the reader will pause to consult a good map or the geological sections given in Prof. Hayden's reports to the Government of this region, he will see that the mountain region of the Arkansas river is about one hundred and fifty miles long by sixty wide, with almost the same formations on each side; that Leadville and Oro City, in California Gulch, are at the extreme northeastern corner of this mountainous tract, while the Rosita mining district is nearly at the southwest corner, and looking down into the beautiful Wet Mountain valley, which I am told is one of the garden spots of Colorado.

With these two rich mineral districts at each extreme, would not the proper deduction be that in the whole intermediate country the probabilities are that just as rich spots are to be found? It cannot be otherwise when we take into consideration that the tract contains innumerable mountains and gulches, all of which as far as explored show to the prospector many evidences of concealed mineral wealth. Following this line of reasoning, are not the chances of the prospector, the miner and the capitalist much better outside the points where the most intense excitement is—the one to obtain an individual competence the sooner, the other to secure the most valuable property for the smallest outlay of cash? While, on the other hand, the merchant and speculator will naturally gravitate to the point

where the greatest rush is for the time being, only to pull up stakes for another place when a new discovery brings it into popular favor. From present indications I foresee that the speculator will be kept moving in this country pretty lively for the next five years, as such an era of mining excitement has set in that I can liken it to nothing as a comparison except the "oil fever" of fourteen or fifteen years ago. There is this difference though: the property will be divided among a large number of owners, and not allow the same opportunity for monopolies.

The next query is how to get there. The competing railroads are perfectly capable of tooting their own horns, and will probably reap as great a harvest as any one, which is right; as to the energy of the managers of those corporations we owe the present rapid development of this country; and let those who do not believe in those corporations as means of good either stay at home, or, if they must come, this is still a free country, and there is one privilege no "grinding monopoly" can take from them—they can walk.

Many purchase tickets at Kansas City via the Atchison, Topeka & Santa Fe Railroad to Denver. Coming to Pueblo, Colorado, and, concluding not to go to the mountains from Denver, they dispose of the balance of their railroad ticket and come up to Cañon City instead, and from there get to the nearest mining camp; or, if they wish to penetrate farther, the means of transportation are quite as good (and growing better) as from any other point. Traveling by way of this route, one will see the best of the State of Kansas in an east and west line. You leave Kansas City at 10:45 a. m., and in twenty-six hours you are at the Pueblo depot. You will dine at Topeka, sup at Florence and breakfast at Lakin. After passing Newton, Kansas, you soon enter the Arkansas valley, and such easy railroad riding I never had; the rails seemed as if laid on a floor, so smoothly did the train roll over them. Soon after passing Las Animas, Colorado, you will come in sight of the mountains, the Spanish Peaks to the south, and, by the time you have taken in their snow-clad summits, behold Pike's Peak in all its glory looms up to the northward. To one unaccustomed to such grand natural guide-posts it seems as if he could not watch them close enough; so varied are the changes that come over them of sunshine, cloud, snow and ever-changing distance, that he feels as if, in looking from a car-window, it was a grand kaleidoscope of Dame Nature that he was peeping into.

The sorriest sight of the whole ride was the many dead cattle we saw. They lay where they fell on the plain, in the gullies, and by the river-side, starved to death, the effects of this unusually severe winter and heavy snows.

As you approach your journey's end the river valley narrows, the foot-hills become closer, until finally your train rushes into a deep cut in a kind of irregularly bedded soapstone rock overlaid with many feet of gravel, to emerge at the other end into a huge natural gravel pit. Herein is the place that Pueblo is built.

Desiring to commence at the beginning, and pass nothing by from which I might learn, I stopped here twenty-four hours. I found the mesa or table-land that surrounds Pueblo on the west, north and east but a huge gravel deposit,

out of which the Arkansas river has scooped a nice, sunny basin, opening to the south, and in this basin the town is laid out. The population is about 5,500, and while I was there I could not get rid of the impression that it was Sunday, so quiet did it seem. On inquiry the fact was revealed that one-half the population was at Leadville at present, and the other half sorry that they could not go. The town is garnished with a well-built court-house and school-houses, and is furnished with water-works—the Holly system—while the fine brick residences on the surrounding mesa add materially to its substantial appearance. The place of most interest to me was the silver reduction-works of Messrs. Mather & Geist, situated quite near to the railroad cut spoken of before. The chimney of the works is built on top of a hill, and the building containing the furnaces near the bottom; a long flue running up the hill-side connects the two, and the distance is such that most of the vaporized precious metal is deposited and saved within it, while otherwise it would be lost. There are three furnaces, capable of reducing seventy-five tons of ore per twenty-four hours, each furnace running from eight to ten weeks before choking up; this is owing to the suitable character of the flues used and the care taken in keeping up an even temperature. Each furnace is square in shape, with two openings for running off the slag, and two more smaller through which the metal is continually emerging into a small pot built into the brick-work, and from there ladled into iron moulds containing about 150 pounds each, and shaped very much like bars of pig-iron. In this condition it is called base-bullion, and is ready for shipment East, where it can be still further reduced more economically. The slag is drawn off into large, iron pots mounted on wheels, and when cool enough is wheeled into the yard, dumped and broken up, quite a large button of metal settling at the bottom, which is saved to go again through the furnaces. The coke comes from Trinidad, Col.; the iron ore flux, from Garland; while the limestone used is obtained about four miles up the river, where it is loaded direct on the cars from the quarry, the Narrow Gauge road having a switch-track to the works, as does also the Atchison, Topeka & Santa Fe Railroad, standard gauge, making railroad communication with the whole country. I was somewhat surprised to learn that Cañon City coals would not coke, while those from the north contain too much sulphur to be as good for smelting purposes as the coke obtained from Trinidad. The ores used are shipped from Rosita, Col., and Leadville, consisting of argentiferous galena from the "Ben Franklin" mines, some carbonates from the "Bassick" of the first place, and all carbonates from the latter. The Rosita ores are hauled to the works in wagons; the Leadville ores are hauled to Alamosa, Cañon City and Colorado Springs, and from there shipped by rail. Of the Leadville carbonate—well, I have seen many clay-banks that looked as rich although there is a perceptible difference in the specific gravity; in color they resemble the clay-banks of Kansas City, while the "Bassick" ore was a light yellow and much richer in "pay." The ores are shipped in sacks weighing from seventy to one hundred and fifty pounds. Some is received in bulk from Leadville at present, the quantity taken out being greater than can be properly packed; to this

there must be some waste in the long haul by wagons, and where, of course, a saving will be effected in time.

It is a real pleasure to visit works conducted as these are. Although many men are employed, there is no confusion or noise. Each man appears to understand his duty and does it. The proprietors give personal supervision to every thing, and as I watched the men carrying sacks of ore into the building, previous to weighing, I heard the manager cautioning the men to be careful in handling some sacks in which small holes were worn, that no ore might be wasted. It is such close and careful attention to the interests of their customers as this that is giving these works an enviable reputation among mine owners; for, as near as I could understand it, the smelting-furnace stands in the same relation to the miner that the grist-mill does to the farmer, and is conducted on much the same basis. As the ore is received after weighing, an average assay is made; a deduction of ten per cent made for loss, or difference between assay returns and actual working product. A charge of thirty dollars per ton is made for reducing, and the balance paid the shipper at once, the price being based on the price of silver per ounce on that day.

From here I go to Rosita, via Cañon City, where the mines are the most developed of any in this part of Colorado. There I hope to learn of some practical facts in actual mining that I trust will be of interest at a future time to the readers of this Magazine.

THE COLDEST DAY IN MANY YEARS.

EDITOR KANSAS CITY REVIEW OF SCIENCE:

Dear Sir—Being satisfied, from a personal acquaintance with you, that your object in the publication of the REVIEW is to present facts in all cases and on all scientific subjects where they are to be obtained, I herewith offer a correction, or rather an amendment, to an article published by you in the January number, whereiu you gave a list of the coldest days in Kansas City during the past twelve years. You omitted the 29th of January, 1873, which was undoubtedly the coldest day we have experienced within the memory of the gentleman so often referred to in such cases, "the oldest inhabitant." Upon that morning the thermometer at my office at the Kansas Stock Yards indicated 34 degrees below zero at 7 a. m., and one at my home on O. K. creek, south of the city, was not spaced and marked lower than 32 degrees below zero, but at 6:30 a. m. the mercury was *below that point*, and only rose to it after the instrument was taken into the house, (under the impression that it was broken.) I well remember of hearing, during the day, of other thermometers indicating from 30 to 38 degrees below zero, one in particular being at the Kaw Valley Hotel, where the mercury stood at 36 degrees below zero early in the morning. All passenger and stock trains were delayed, owing to the engines being unable

to work their pumps. I have referred to the files of the *Daily Journal* on the subject, and in its issue of January 30th I find the following notes:

"At Wyandotte the thermometer fell to 32 degrees below zero, and in some exposed places as low as 40 degrees." * * * * * * * "At Armstrong the thermometer at 6:30 a. m. yesterday was 37 below zero, and at 12 m. 28 below; hardly a person could be seen out, and it was only with the greatest difficulty that the engines belonging to the K. P. R. R. could be kept moving." "In Kansas City, Kansas, the thermometer at 6 a. m. fell to 38 degrees below zero, and in some places the mercury froze, so that it was impossible to tell the exact temperature." * * * * * * * "At the residence of Mr. Jones, on Delaware and Sixteenth streets, yesterday morning at 5 o'clock the thermometer indicated 27 degrees below zero."

Thus the records of the day bear me out even stronger than I require in statements I have made in conversations on the "cold snaps," statements that have been denied as being too improbable for belief.

Respectfully yours, H. P. Child.

Kansas City, March 5, 1879.

ASTRONOMY.

THE GREAT PYRAMID IN CONNECTION WITH THE PLEIADES;

Or, The Last Anniversary of the Great Year of the Pleiades. When, How, and Why Celebrated.

BY REV. JAMES FRENCH, DENVER, COLORADO.

The time during which the fixed stars make one revolution is called a Great Year. This period begins with the right ascension of a sign of the Zodiac, and ends when this sign has completed its 360 degrees. It takes 25,827 solar years to make one Great Year. The Pleiades are a beautiful cluster of stars, and the most conspicuous group in the sign or constellation Taurus. Its principal star, Alcyone, was on the meridian a little north of the celestial equator, in the zodiacal belt, at 0 hour, right ascension, at midnight of the vernal equinox, B. C. 2170 years, and marked that date as the beginning of a Grand Cycle. This is called the "Great Year of the Pleiades," in honor of the unique group of stars which keep the record of its age.

Coincidently with the beginning of this Great Year another star, Thuban (the Dragon,) was on the same meridian, near the North Pole, distant from it 3° 42′. Here was one conspicuous star exactly south, making sidereal time, and another conspicuous star exactly north at the same time, so that straight rods pointing to each would indicate north and south more exactly than the needle of the compass. If these rods were fixed as pointers to the north and south, they would aim like

guns to their respective north and south stars once every night. This exceedingly rare coincidence in star-pointings occurred at the epoch of the Great Pyramid and on the anniversary of the Great Year of the Pleiades. Its star-pointings symbolized that date and no other.

That there is nothing fanciful in this theory of accounting for the design of the Pyramid's erection, we show by referring to scientific authority of a high order. Sir John Herschel, a distinguished astronomer and the son of a distinguished astronomer, noticed the peculiar entrance to the main avenue of the Great Pyramid, fifty feet up from the base, so high and difficult to reach as to make the entrance extremely inconvenient, and he wrestled with the query, Why an entrance so inaccessible? His cultivated genius soon furnished the correct answer to his question. He discovered that the angle of declination in that avenue pointed exactly 3° 42′ below the Pole, which was precisely the spot where the North Star Thuban would be seen when on its meridian, at its lowest culmination, when the Pleiades were on the same meridian south and just commencing the round of a Great Sidereal Year; and the design of erecting such a structure, at such a peculiar point of time, seemed to him "to *memorialize*, or, farther still, to *monumentalize* a particular phenomenon of that day when it was being built, and of that day only."

In accordance with this testimony (based on astronomical observations) is the argument in the article on Astronomy in the American Cyclopædia. The author says: "We may accept the conclusion relative to the position of the North Star of that period, so as to shine down that entrance-passage," and adds: "This would set the epoch about the year B. C. 2170." Then he adds farther: "It is a remarkable fact that, as Prof. Smyth points out, the Pleiades were at that time in a most peculiar position, well worthy of being *monumentally commemorated*, for they were actually at the commencing point of all right ascensions, or at the very beginning of running that great round of stellar chronological mensuration * * * * which has been called elsewhere, for reasons derived from far other studies than anything hitherto connected with the Pyramid, the Great Year of the Pleiades."

Not only is this theory supported by the opinions of very eminent astronomers, but it is ascertained to be oriented wonderfully correct, more so than some of the most celebrated astronomical observations of modern times. It is admitted that it would have been utterly impossible to have both dated and oriented it so exactly without taking advantage of the most peculiar and exceedingly rare coincidences in star-pointings which occurred B. C. 2170, and at no other time within the round of the cycle of 25,827 years.

We do not mean to say that there have never been two stars, one exactly north and the other exactly south, one near the Pole and the other near the Equator, at any other time coincidentally; but we do say that there have never been two stars, for more than 25,000 years, thus situated at the same time, while the one at the north was exactly 3° 42′ from the Pole, which (it is admitted) must have been the case when the entrance-passage of the Pyramid was constructed,

so as to point not only exactly north, but also at the exact elevation of 3° 42′ below the Pole, when Thuban was situated at that point.

That wonderful entrance-passage, studied astronomically, explains clearly one phase of the object of that huge structure's erection. Directed to the North Star, when it was on the meridian and exactly 3° 42′ below the Pole, coincidently with the commencement of a Grand Cycle, it clinches the argument determining the date astronomically. That entrance-passage, if it had been pointed to the North Star at any other date, would have inclined more or less than it did, according to the distance of said North Star from the Pole. If it were pointed now to the same star, it would incline so as to aim, not at 3° 42′ below the Pole, but to a point *seven times* that distance from the Pole.

But the question may be asked, Might not a North Star alone be sufficient for the purposes intended in the erection of the Great Pyramid? We answer, a North Star alone might possibly be sufficient as a guide to approximate orientation, without reference to chronology. But a North Star, so near the Pole, has too small a circuit around the Pole, and moves too slowly to mark sidereal time. It would be like counting the revolutions of a large wheel on its extremely small hub instead of on its rim. To mark time accurately, the assistance is needed of an equatorial star, moving over a much larger circle and with much greater velocity. The two stars, one at the Pole and the other at the Equator, were essential to both orienting and dating the structure. Hence the conclusion that the Great Pyramid could not have accomplished its design as a monumental witnessing pillar at any other time, and that the only time when the aid indispensable was possible was B. C. 2170.

Richard A. Proctor, the peer of Herschel and Smyth as an astronomer, but an unbeliever in the inspiration theory as connected with the building of the Pyramid, says there was one other time when it would have been possible to orient it as they did. This was B. C. 3440, when the star Thuban (Alpha Draconis) was moving toward the Pole, as it was B. C. 2170 from it. He regards the founding of the Great Pyramid as "practically certain" on one of these tw epochs, thus disposing of all the estimates of all the different schools of chronologists put together with the sweeping declaration that, "Gentlemen scientists, your suppositions are not within the limits of possibilities!" Very candidly for a sharp critic, however, while he claims that the Pyramid could have been oriented at either of these dates, he admits that it could not possibly have been both oriented and dated only at the later time of B. C. 2170. He says there is "a degree of accuracy rendering it practically certain that some stellar method was used in orienting the base." But as if unfavorable to the earlier date, he remarks of the North Star (towards which the entrance-passage pointed B. C. 3440): "It could not have been intended to be used for observing meridian transits of the stars in order to determine sidereal time." The aid of the other star, South, on the zodiacal belt, in connection with the one 3° 42′ below the Pole, toward which the entrance-passage pointed, was essential to making the date of the Pyramid simultaneously with its orientation. These two scientific performances were pos-

sible only at the later date, B. C., 2170. So, admitting all that this eminent critic claims with regard to the epoch as being hypothetical, as between two dates, the preponderance is overwhelmingly in favor of the later one.

All that can be brought to bear in favor of the earlier date is the bare possibility that the structure could have been sidereally oriented at that date. But that it was then oriented is not supported by any concurrent testimony whatever, either by historians or scientists, nor would it have been possible to have performed the more important scientific work of recording its date ("in some stellar method") on that occasion. Whereas the later epoch has in its favor the concurrent testimony of historians in general till the beginning of the present century, together with the opinions of very eminent astronomers; the evident design in its erection, to establish a standard of measures (which, to be perfect, must include a starting point from which to measure time), its own independent symbolical scale of time measures, and its harmony with the Bible, not merely in tracing the origin of the Egyptians, but in marking age.

That this date, B. C., 2170, is in harmony with accredited history at the close of the last century accords with the well-known pithy language of Napoleon at the battle of the Pyramids when his army, all footmen, were attacked by the splendidly equipped Mameluke cavalry. They formed in hollow squares, with cannon at each corner, and, as they mowed down the enemy, Napoleon cried out to his army, (as he pointed to the Pyramids): "Soldiers! Forty centuries look down upon you!" After this commenced the lengthening of dates, not only prehistoric, but to well-attested historical occurrences, including the date of the structure which is the subject of this discussion.

It is a singular fact that the mania for date-stretching (within the historic period) increased in extravagance among chronologists about in proportion to the degree of their skepticism on divine revelation. But we will call them to the witness-stand and let them testify for themselves.

The French chronologists (or, more properly speaking, date-stretchers) under the lead of Renan, Lesuere and Marriette place the epoch of the Great Pyramid at about B. C. 4956, or nearly 5,000 years before the Christian era.

The Germans, under the lead of Lepsius, Bunsen and others, place it nearly 2,000 years later, at about B. C. 3124. The English, under the lead of Rawlinson, Wilkinson and Lane, place it between 600 and 700 years later than the Germans, at about B. C. 2440.

Osborne, a very reliable English Egyptologist, more especially from a religious stand-point, places it at about B. C. 2228, or within a half century of the date as determined by astronomical calculations. Here is a divergence among highly educated men of science of 2,728 years in the date of a structure built within the historic period. And this is the boasted result of modern scientific research, aided by keys to hieroglyphics and translations of the most ancient languages and the most renowned academies of science in the world. And this wide diversity of opinion relates to the age of man's works, not only within the

historic period, but to works of man still standing in almost as perfect a conditoin as when they were made.

Now, what are we to infer from this discordance of scientists on a subject so important? If it were submitted to them all jointly as a jury, to determine, from all the evidence they have been enabled to obtain, when was the Great Pyramid founded? Their verdict probably would be "*not agreed.*" But there is no disagreement of this kind among that class of scholars, who determine its date astronomically, even though they differ widely in their religious views. Then, too, the astronomical determination harmonizes not only with history, but to the fraction of an inch with its own testimony, recorded in another manner entirely independent of this, on its own symbolical scale of time measures.

Farther, a monument embodying perfect science (then unborn, so far as we know), especially all kinds of measures, would betray more imperfection in its founder in omitting to mark its epoch (when such a mark was possible) than it would in omitting to *orient* it. Both performances would be of a highly scientific character; but the dating of the structure would be the more important of the two, as it would enable people in the distant future to know what, we now see, cannot be known without it, and to measure time accurately, as it would be impossible to measure it without the stellar aid furnished by the Great Pyramid's record.

So, we see here, this wonderful witnessing pillar is not merely abreast of scientists on chronology, but it is very far ahead of them; it annihilates at one sweep all the theories of all the long date, and short date, and intermediate date schools of chronologists (whether infidel or Christian) based on any other than the true astronomical basis. It becomes the one final arbiter to adjust all conflicting estimates, from whatever source, within the whole historic period of more than 4,000 years, and especially with regard to its own proper place, in a true chronological scale of time past.

Then, again, it is not without significance that its uniform harmonious correspondence with Bible teachings would lead one to expect that it would very carefully record its age. The foot-prints of old Chronology "on the sands of time," which he made during the fourth Egyptian dynasty over 4,000 years ago, are to-day, distinctly visible at the Great Pyramid. His tracks in those rocks are as perceptible now as when freshly made, and Mr. Astronomer, as clerk upon that occasion, has made a record of that date, which will stand till Thuban and Alcyone are blotted out of the heavens.

If it expands our ideas and conceptions to think of 25,827 years compressed into one *Great Year*, as though it were only one round of seasons, as viewed by celestial beings with bated breath—hear us, while we look up yonder, and our eyes pierce through the azure vault, to where "the heavens declare the glory of God, and the firmament showeth his handiwork," and then view with us on the great clock of the ages (called Job's day Mazzaroth), how principalities and powers in heavenly places take note of time as it passes, and regard that whole long period as only one day.

Forty and a-half centuries ago from the vernal equinox of next year, while everything was transpiring as usual among the idolators of Egypt, who were then at the height of their power and grandeur, that great clock struck the closing hour of an astronomical day. Suddenly at that instant there appeared a shepherd of great influence before King Cheops, whose name in the Egyptian language was Philitis, supposed to be from the country on the border of Canaan, afterwards occupied by the Philistines. Perhaps he was the same shepherd whose influence and power and wealth had been so conspicuous in Uz, and who was the richest as well as the best and purest of men in all the East.

The shepherd Philitis had such influence over King Cheops that he seems to have done by him as a later Pharaoh did by Joseph, "made him ruler over all that he had."

Then the founding of this immense structure (never exceeded in magnitude and the perfection of its plans) commenced, and for the time, in honor of the God of Philitis, all idol temples were closed and the offerings of idol sacrifices ceased, and idol-worship was suspended till this structure was completed. (See Herodotus.)

In looking at Mazzaroth now we see it is not quite IV o'clock, sidereal time. So a little less than four hours of celestial time have passed since that event occurred.

That Job was acquainted with the region of the Great Pyramid, hear what he says about where he would have lain, unmolested, had he perished "as an untimely birth." He says: "Then had I been at rest among kings and counselors of the earth which built desolate places for themselves, or with princes that had gold, who filled their houses with silver." (Job, iii, 13-15.)

Rev. Philip Schaff, D. D., says: "The Bible, as far as I know, alludes but once to the Pyramids." He thinks its allusion here unmistakable, and that the "desolate places" referred to (verse 14) were either the Pyramids themselves or the mausoleums around them, where kings and legislators were entombed.

When the two guiding stars, Alcyone and Thuban, one on the long circle on the Equator and the other on the short one at the Pole, shall, like the hands of a clock, have completed one round on their dial-plate, that is, when they shall have completed their cycle of over twenty thousand more years, where shall we be if immortal? What think you will then be the condition this terrestrial globe?

When Chronology himself shall have grown old and decrepit, and the mighty angel of Apocalypse "shall stand one foot on sea and one on solid land, and swear by him who liveth forever and ever, that time shall be no longer," the material which composes this earth, though changed, will still remain, and its Author and Proprietor will be no more effected by it than we shall be in changing a brush heap into a fertilizer for our garden. Such an event will require no greater changes on the earth during the present Great Year than have occurred during the past.

How will the anniversary of the Great Year of the Pleiades be celebrated?

and who will be witnesses on that occasion? are questions entirely beyond the grasp of our conceptions.

Chronology looks back to when a child,
But scarce remembers when these rocks were piled,
Or chambers laid. But with amazed eye,
He seems to pause with other passers by,
And wonder how the knowledge now made known,
Was put in symbols here, ere books were born."*

*A parody.

MEDICINE AND HYGINE.

VALUE OF ANOINTING IN INFANTILE DISORDERS.

BY H. GUARD KNAGGS, M. D., F. L. S.

During the past eleven months I have been testing, with uniformly successful results, the value of a very simple method of treating such infantile complaints as atrophy, bronchitis, convulsions, diarrhœa, febrile disturbances generally, and indeed all disorders of childhood which are accompanied by an unnatural state of the skin.

The treatment simply consists in smearing with salad oil the whole surface of the body, from the crown of the head to the tips of the fingers and toes, the process being repeated every twelve, six, or even four hours, according to the urgency of the case. Of course, the use of a long flannel gown or small blanket is obvious, and the fluid should be slightly warmed.

The application of oil possesses the following immense advantages over the ordinary warm bath:

1. Skin-action is more completely and permanently restored.

2. The danger of reaction is avoided, for there is no sudden change of temperature; and, moreover, the sheet of oil protects the surface from atmospheric influences.

3. It acts as a fuel-food, not only preventing waste of tissue, but actually increasing the bulk of the little patient.

4. It does not depress, but, on the contrary, appears to exhilarate.

It will scarcely be credited by many that the formidable affections above mentioned will frequently yield to this treatment, or, at any rate, show signs of abatement in from twenty minutes to four-and-twenty hours; but such is the case, though sometimes forty-eight or even seventy-two hours will elapse before any decided signs of improvement occur. By way of illustration, here are a few examples out of many, and I shall be happy to satisfy any gentleman as to their genuineness:

Atrophy.—My cousin, Mr. H. S. Knaggs, was called to see an infant, whom

he found apparently *in articulo mortis.* The mother informed him that she had sent for him "for satisfaction only." The child was oiled, and in twenty minutes began to look about and took its food. In the course of a fortnight it recovered its ordinary health and strength.

Several similar cases have come under my notice. One of them is rather amusing. A brother practitioner himself told me of, and gave me permission to publish, the following conversation. which took place between him and a parish patient: "Whose child is that?" "Why, mine, sir." "But surely not the child that I told you a week or two ago you would never rear?" "It is, though, sir." "Then the medicine seems to have set it to rights." "But it has had none of the medicine." "Then what have you been doing with the child?" "Why, sir, don't you recollect you told me that a friend of yours recommended that sick children should be rubbed all over with salad oil, and that I might try it if I liked, but that you had no faith in it? Well, sir, I did oil it, and the child has been improving ever since."

Bronchitis.—Last January a desperate case came under my care, which, in spite of active treatment, became rapidly worse. As a last resource I smeared it all over with salad oil, and, to my utter astonishment, there was a marked improvement in the breathing in less than twenty minutes. It a few hours the bronchitis entirely subsided.

Another case—double capillary bronchitis, neglected for several days—came under my relative's notice. He considered it too far gone for medicinal measures, and, therefore, ordered it to be oiled every four hours. The next day the symptoms had diminished in severity, and on the morning of the third day the child was sitting up in bed taking food, and to all appearances convalescent.

Convulsions.—In these cases the effect of oiling is sometimes truly surprising, the fit ceasing before the completion of the operation and not subsequently returning. A patient informs me that whenever she observes the symptoms which used to precede convulsions in her boy, she at once oils him, when a calm sleep follows, from which the child wakes up refreshed.

Diarrhœa.—Some time since my cousin had an uncontrollable case of diarrhœa under his care in a child of seventeen months. I advised him to give oil a trial; but he said it was too far gone for anything to be done. I saw the little sufferer myself a day or two afterwards, and ordered it to be oiled every six hours. There was a marked improvement immediately after the first application. By the next day the prostration was gone. Previous to this attack the child was a "puny little thing," but now (oiling three times a week having been persisted in up to the present time) it is "a splendid boy."

Enlarged Liver in a rickety child, with bronchitis supervening.—This case had been under the care of a well-known hospital physician, who gave it up, saying that nothing more could be done for it. I ordered it to be oiled every six hours. After each application a calm sleep followed. In about seventy-two hours the bronchitis began to give way, and a few days afterward the liver was observed to have diminished in size. The child has not since ailed.

Such is a sample of a few of the cases which have come under my notice. Did I not confine these notes to infantile disorders, a long string of other complaints, which are to be benefitted or cured by oiling, might be added. It seems as though the good old Greek and Roman practice will have to come up again. Such is progress!—*The Lancet, January 22, 1878*

ALUM IN BREAD.

Dr. W. A. Hammond, of New York City, expresses himself as perfectly certain of the injurious effects of alum, whether used alone to whiten bread or as an adulterant of baking powder. As to the claim advanced that the alum was neutralized and changed into an insoluble salt, he says that this was a wholly improbable assumption, since such a perfect change could not take place unless the amounts of the alum and the bicarbonate of soda were combined in the exact chemical ratio necessary for each to absorb all of the other. Not only was this impossible in the manufacture of large quantities of baking powder, but the homogeneous character of the compound could not be exactly maintained throughout the whole mass, and, therefore, there would be sure to be a certain amount of free alum in any bread made with an alum baking powder. But even if the exact proportion were maintained, the salts formed would retain their injurious properties, as they would be dissolved in the gastric juice. The gastric juice contained not only lactic acid, but a large amount of hydrochloric acid, and both the sulphate and hydrate of alumina would be dissolved. The phosphate might not be, but in that case the bread would be deprived one of its most desirable ingredients, making the use of alum not only dangerous to the stomach, but deteriorating to the food. The hydrate of alumina, Dr. Hammond says, would certainly be injurious to the mucous membrane. It would inevitably tend to constipate the bowels and interfere with digestion, and anything that tends to render the albumen of the bread insoluble, and therefore takes away its nutritive value, is injurious.

SCIENTIFIC MISCELLANY.

ANCIENT TENURES AND JOCULAR CUSTOMS.*

BY W. H. R. LYKINS, KANSAS CITY.

For the amusement of the readers of the REVIEW, and more particularly those of them belonging to the legal fraternity, I have spent some of the leisure time afforded me by a recent confinement to the house in collating the following

**Fragmenta Antiquitatis*, or Antient Tenures of Lands and Jocular Customs of some Manors: By James Blount, of the Inner Temple, Esq., 1679.

items of old English law and custom, from a work written in 1679 and now so rare that probably there are not more than three copies in the United States. The author, Mr. Blount, was quite a prolific writer, having published, among other works: *The Academy of Eloquence, containing a compleat English Rhetoric*, Printed at London in the Time of the Rebellion, and several Times after; *Glossographia*, or a Dictionary interpreting such hard Words, whether Hebrew, Greek, Latin, Italian, &c., that are now used in our refined English Tongue, &c., London, 1656; *The Lamps of the Law and the Lights of the Gospel.* London, 1658. Written in Imitation of J. Birkenhead's *Paul's Church-yard*, and published under the Name of *Grass and Hay withers; Booker Rebuked*, or Animadversions on Booker's *Telescopium Uranicum* or *Ephemeris*, 1665, which is very erroneous; Quarto in one Sheet, which made much Sport among People, &c., &c.

The work is divided into four heads, viz.: Of Grand Serjeanty; Of Petit Serjeanty; Of Lands held of Subjects by Services, &c.; Of Customs of Manors, Antient modes of Tryal and Punishments, Antient forms of Grants, &c.

Among the Grand Serjeanties, by which the nobility of England acquired, and their assistants retain, their estates, were those of assisting at the coronation of kings and queens, the celebration of their birthdays, personal attendance in times of war, etc. Thus, among the services rendered by the Lord Great Chamberlain of England, and for which he received a magnificent compensation in lands and titles, were the following:

"To him belongs *Livery* and *Lodging* in the King's Court and certain *fees* due from each *Archbishop* and *Bishop* when they do *Fealty* and *Homage* to the *King*, and from all the *Peers* of the Realm at their *Creation*, or when they do *Homage* or *Fealty;* and at the *Coronation* of every King he is to have *forty ells* of *Crimson Velvet* for his own *Robes;* and on *Coronation Day*, before the King rises, he is to bring his *Shirt*, *Coif* and *wearing clothes*, and, after the King is by him apparelled and gone forth, to have his *Bed* and all the *Furniture* of his *Bed-Chamber* for his *Fees*, and all the King's Night apparel, and to carry at the *Coronation* the *Coif*, *Gloves* and *Linen* to be used by the King upon that Occasion; also the *Sword* and *Scabbard* and the *Gold* to be *offered* by the *King*, and *Robe-Royal* and *Crown*, and to *undress* and *attire* the *King* with the *Robes-Royal*, and to serve the King that Day with *Water* to *wash* his *Hands*, and to have the *Bason* and *Towels* for his *Fees*," etc.

The clergy also came in for a full share of the distinctions and emoluments due for their services: The Dean and Chapter of Westminster claiming, at the coronation of King James II., "to instruct the *King* in the *Rites* and *Ceremonies* used at the coronation; to assist the *Archbishop* in Divine service; to have the custody of the *Coronation Robes;* to have *Robes* for the *Dean* and his three *Chaplains* and for sixteen *Ministers* of the said church, the *Royal Habits* put off in the church, the several *Oblations*, *Furnitnre* of the *Church*, *Canopy*, *Staves* and *Bells*, and the *Cloth* on which their Majesties walk from the west door of the church to the theater," &c.

Peter Picot held the half of Heydine by the serjeanty of serving with a towel

at the coronation of the king, and Peter, the son of the above, held the other moiety by the serjeanty of serving with the basin.

Robert Agyllon held one carucate of land in Surrey by the service of making one "Mess in an Earthern Pot in the Royal Kitchen, the said mess to be called *Diligrout,* and if there was Fat or Lard in it, it is called *Maupigurnum.*" This mess was made, presented and served to Charles II., who accepted the service, "*but did not eat of the Pottage.*" But we greatly fear that if any of the family were called upon at the present day to prepare Diligrout, they would make a "mess" of it indeed, for in Knight's Pictorial History of England we are told that the recipe is now lost.

Robert de Marmion, the well-known Lord

> "———— of Fontenaye,
> Of Lutherwood and Scrivelbaye,
> Of Tamworth tower and town,"

held his possessions by the service of hereditary Champion to the King, an office which his ancestors had held, before the days of the Conqueror, to the Duke of Normandy.

Solomon de Campis (or At-field) held certain lands in Kent by the serjeanty of *holding the head* of the king in his sea voyages between Dover and Whitford.

John de Warbleton held the manor of Shirefield by the serjeanty of being Marshal of the Laundresses, and dismembering the condemned malefactors, and measuring the gallons and bushels in the king's household.

Roger Corbet, for the manor of Cheltington, in the county of Salop, was to follow his sovereign to the wars, bearing one bow and three arrows, with a "bacon," or salted hog, and to continue in service until he had eaten one-half of said hog. In case of great danger it may be presumed that Roger was expected to "go the whole hog."

Among the Petit Serjeanties were the furnishing men, horses, arms and equipments, etc., for the army in times of war; also, performing certain legal services, such as keeping the gaols, acting as sheriffs, bailiffs and marshals; also, rendering such services as "finding litter for the king's bed and hay for the king's palfrey," and furnishing clothing and food for the king and his household. John Campes held the manor of Finchingfield by the service of turning the spit at the coronation of Edward III. Thomas Winchard held land in Comingston by the service of saying daily five *Pater Nosters* and five *Ave Marias* for the souls of the king's progenitors, etc. Peter de Baldwyn held a certain serjeanty in Surrey by gathering wool for the queen from the white thorns, if he chose to do it; and if he refused, to pay twenty shillings a year instead.

In the Middle Ages the grotesque, the romantic and the warlike filtered their way through the most commonplace business transactions. Nowadays, to hold real estate, though an agreeable occupation, cannot on the whole be considered singular or peculiar. John Smith buys land, gets his papers, and henceforth his only difficulties are with tenants, taxes and other commonplace business transactions. Far different was it during the days of John's ancestors, when Johan de

Smythe held his *hyde* or *carucate* of land by the honorable service of the sword, or it may be he was *enfeoffed* of the hyde or carucate aforesaid on condition of finding the king in *gingerbread* (Paris piperatis), or of dancing a jig before the court on Christmas morning, or of some equally absurd act.

The conveyances of land were also grotesque and ludicrous. But for fear of occupying too much space, I conclude by quoting the rhyming grant made by William the Conqueror to "The Heyrs made of the Hopton, lawfully begotten:"

"To me and to mine, to thee and to thine,
While the water runs and the sun doth shine,
For lack of Heyrs to the King again,
I, William, King, the third Year of my reign,
Give to the Norman Hunter,
To me that art both Lone and Deare,
The Hoppe and Hoptown
And all the Bounds up and Downe,
Under the Earth to Helle,
Above the Earth to Heaven;
From me and from mine
To thee and to thine,
As good and as faire
As ever they mine were;
To witness that this is sooth,
I bite the White Wax with my Tooth
Before Jugg, Marode and Margery
And my Third Son, Henry,
For one Bow and one Broad Arrow,
When I come to hunt upon Farrow."

THE SILK INDUSTRY OF EUROPE.

The mother country of the present silk industry of Europe, says the *Textile Manufacturer*, is, without contradiction, Italy; the climate is specially adapted to the rearing of the silk-worm, and consequently the cultivation of silk has been carried on in that country for centuries, so that silk tissues are perhaps more used and cheaper there than—with the exception of Turkey—in any other continental state. The principal seats of the silk industry of Italy are Como, which alone has 7,000 looms, Turin, Genoa, Milan, Florence and Rome, in all of which towns hand looms are abundant. In fact, of the 20,000 looms running in Italy, only about 300 are power looms. There are only 25,000 fine spindles in the country, which tends to show that the silk industry is more of a domestic occupation than a factory one. Silk furniture damasks are manufactured at Turin, Vicenza, Navarra, and other places of minor importance.

From Italy the silk industry was transplanted about five centuries ago to France, and has there taken such root as to have become one of the chief industries of the country. The center of manufacture, formerly in Touraine, has now fixed itself at Lyons. Silk throwing and spinning is carried on in about 500 large or small establishments, occupying 70,000 hands. Silk waste, an important article

when so much is spun, gives employment to fifteen establishments, with 75,000 spindles, the waste being supplied by damaged or badly-reeled cocoons by the processes of combing, throwing, etc. Silk weaving is principally carried on at Lyons, supported by a large country district; also at Tours and Nismes. St. Etienne is the seat of the ribbon manufacture. Mixed goods of silk with wool or cotton are produced ot Paris, Roubaix and in Picardy. The total production of silk goods in France is estimated at £22,000,000 per annum, and the principal export is now to Great Britain, though formerly America took the largest portion until the United States raised their tariff to an almost prohibitive height. With the exception of the greater utilization of waste in the production of useful yarn, little progress or change has been made in the manufacture; even power looms are only used to a limited extent.

SEASONABLE HINTS FOR FLORISTS.

With March almost any flower-seeds may be sown. Choose a time when the surface is a little dry and the earth will powder under a slight blow. Sow the seeds shallow, barely covering them, but beating the dryish earth firmly after sowing.

Divide herbaceous plants when required; this work cannot be done too early. If delayed till after the plants have grown into leaf, the flowering will be very weak.

Plant trees and shrubs as soon as the earth is a little dry. Ram the earth tightly about the roots. Few do this work well, and more trees die from loosely filled in earth than from any other cause. Trees never need water at transplanting if the earth is rammed in tight enough. If the roots have been injured in digging, or the branches or roots are somewhat dry, prune the branches accordingly. Fibrous-rooted trees suffer more from drying than those with a few coarse roots.

In laying out new places of small extent, be careful of aping "principles of landscape gardening" that are only applicable to places of large extent. Remember that everything we do should have a meaning, and that this meaning as often depends on the time and circumstances as on any real existence in the principles themselves. It will be a failure to attempt to make a two-hundred-foot square lot look like a "country place." It is better to make the gardening border a little on the artificial. In this, terraces, vases and architectural objects will afford much assistance; and neatness, polish and finish generally be more pleasing than the sober negligence that should characterize a more quiet and extensive natural scene.

Shrubs are not near enough employed in planting small places. By a judicious selection, a place may be had in a blooming state all the year; and they, besides, give it a greater interest by their variety than is obtained by the too frequent error of filling it up with but two or three forest trees of gigantic growth. Plant thickly at first, to give the place a finished appearance, and thin out as they

grow older. Masses of shrubs have a fine effect on a small place. The center of such masses should be filled with evergreen shrubs, to prevent a too naked appearance in the winter season.

Ornamental hedges judiciously introduced into a small place add greatly to its interest. No easier method offers whereby to make two acres of garden out of one in the surveyor's draught. The Arbor Vitæ, Chinese and American Hemlock, Holly, Beech, Hornbeam, Pyrus Japonica, Privet, and Buckthorn may be applied to this purpose.

It is well to again remind the reader of what we said last month; not to lay out too much work for the year, but to see that what is planned is executed taste fully and well. The true art of gardening does not consist so much of having everything on one's ground as in the combinations. One thing should be made to help the other. The garden should not be merely a collection of all sorts of things like a museum, but the collection should form one delightful garden. Even plants that are weeds in some situations can be made very effective in the make-up of a garden.—*Gardener's Monthly.*

To reach the ore in the Leadville mines it is necessary to pass through from twenty to sixty feet of regular wash gravel, containing bowlders from the size of a man's fist to a ton's weight. After this comes a formation of what is called porphyry, but which is said not to be porphyry at all. It is a white substance containing mica, and which, in the Winnemucca mine, is sixty or seventy feet thick. When first this is encountered it is hard, but next to the ore vein it is soft, and is called "Chinese wax." This is a pliable white clay of the same constituents as the harder formation, but more disintegrated. Then comes the ore vein, from two to thirty feet in thickness. The ore is a carbonate, very similar to that of the Base Range at Eureka. It has some knots of galena in it. Under this ore is a formation of ironstone, and this in turn rests on limestone.

EDITORIAL NOTES.

THIS number completes the second volume of the REVIEW, and, in closing, we do not know that we can do better than to repeat what we said a year ago—that upon looking over our work we are tolerably well satisfied with it. Our effort at all times has been to make the REVIEW an acceptable visitor to all classes of readers, and with this view we have been compelled to procure our articles from a large number of sources. Fortunately our contributors have used their talents upon diverse subjects, and our exchanges comprise periodicals, both English and American, devoted to almost every branch of science, so that our task has been comparatively easy after all.

A reference to the copious index accompanying this number will show that a surprisingly large number of popular and technical subjects have been treated this year.

It is a matter of pride to us that so many of the distinguished scientific men of the country have deemed the REVIEW a suitable medium for placing their ideas, theories, records and discoveries before the reading public, and we have assurances that there

will be no falling off in this respect in the future.

We have given our readers 768 pages of well-printed, substantial and reliable reading matter, comprising original articles by more than thirty able writers, and selected from a list of over fifty of the best scientific, medical, educational, agricultural and literary periodicals in the world, and have distributed for our advertisers 12,000 copies of the REVIEW in more than half of the states of the Union, but principally in Missouri, Kansas andColorado, where it has reached not less than four or five times as many readers.

The REVIEW has been warmly welcomed, and many of its articles copied by the press of this country and England, both scientific and literary, and has been quite as well patronized, especially in Kansas City, as could possibly have been expected, considering that it is the first publication of the kind which has ever been started in the West. Another year we shall hope to improve it in several respects; however, still further attempting to adapt it to the popular rather than to the strictly scientific taste. We shall also hope for an increased support, both at home and at a distance; at least sufficient to maintain it.

AT the February meeting of the Kansas City Academy of Science, Hon. R. T. Van Horn read the principal paper of the evening, entitled, "Life and Life Theories," which was an able and exhaustive review of the whole subject from the respective rtandpoints of the evolutionists and the advocates of creation, closing with some modestly expressed theories of the writer, which were, as was the whole essay, received with warm approbation. The paper will be found in full in this number of the REVIEW and will repay the reader abundantly.

Professor Parker's remarks on the connection or sympathy between the barometer and the magnetic needle will also be found in this number. At the next meeting of the Academy Dr. Fee will read an article upon Philology.

THE commencement exercises of the Kansas City College fo Physicians and Surgeons, on March 4th, were more than usually interesting. The addresses by Professors Taylor and Todd, and the remarks of President Thacher were appropriate and exceedingly well received; but the feature of the evening was the admirable address of Rev. Dr. Roberts, on "The Relations of Superstition, Skepticism and Faith to the Progress of Science," which will be found in this number of the REVIEW. The success of this medical school is very gratifying to its friends, and it is a credit to the West.

HON. E. H. ALLEN, of this city, recently delivered an address at the Kansas University, Lawrence, Kansas, which, according to the comments of the various literary and secular papers of the city, was fully up to his high standard in ability and eloquence.

THE *London Quarterly Journal of Science* (now monthly) copies the latter portion of Mr. Ermine Case's article on ornithology in the November *Review*, under the head of "Reason or Instinct?" while, in the same month, the *London Literary and Scientific Review* copied the first half of it under the head of "Peculiarities of Western Ornithology."

The article on "Peruvian Antiquities," by Dr. Heath, and the "Pyramid" papers, by Rev. James French, and many others, have also been widely copied, showing that the REVIEW is not without readers in the East as well as the West, and also across the Atlantic.

ALL subscribers who have lost or missed any numbers of the first or second volume can have them supplied *gratis* by the editor, and they can also have either or both years' numbers handsomely bound in half morocco and cloth sides *for* $1.00 *per volume.*

OUR former fellow-citizen, General Bingham recently prepared a lecture on "Art; the Ideal of Art and the Utility of Art," which was read at Columbia, Mo., March 1st, by Major Rollins (on account of the author's illness), and received the warmest commendations of the local papers.

WE have received all the current magazines and periodicals, as usual, besides numerous valuable books, magazines and pamphlets, but our columns are so full, in closing the volume, that we are compelled to omit the notices they deserve for this time.

THE REVIEW has been regularly sent to several friends during the past year without first obtaining their consent, owing to the fact that the editor is fully occupied with his regular business during the day and can devote himself to editorial work evenings only, and consequently has had no time or opportunity to canvass for subscribers. It is hoped, however, that all such have been well enough pleased with the REVIEW, not only to pay for it, but to continue to read it in the future.

PREMIUMS TO SUBSCRIBERS.

We have determined to adopt a new, and, as we think, appropriate and acceptable plan for giving premiums to our subscribers, viz:

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